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A 19-hour train between Chicago and New York is contemplated by the Pennsylvania R. R., to rival the train which is to be put on by the New York Central, as noted in our issue of April 13. An experimental train of five cars was sent over part of the line on April 11, from Pittsburg to Chicago. Deducting the stops of 18 minutes in all from the running time, the distance of 136 miles was made in 122 minutes, or at a rate of 66⅔ miles per hour.

The city council of Chicago on April 11 granted a franchise to the Waukesha Hygeia Mineral Springs Co. which permits the company to lay pipes in every street, avenue and alley of the city for the distribution, according to the Chicago "Record," of "mineral or spring water from the springs of southern Wisconsin." The franchise provides that only one pipe shall be laid in each street and that the pipe shall not be more than 12 ins. in size, but it also provides for "all necessary feeders." No streets or avenues are to be opened between May 1 and Nov. 1, 1893, and the commissioner of public works may require any work upon the streets and alleys to be done between 8 p. m. and 7 a. m. As a consideration for the privileges granted the company must pay into the treasury of the city of Chicago annually 3% of the gross amount received by it from the sale in the city of water conveyed through the pipes.

The ordinance granting the franchise was passed at the last meeting of the council, after great opposition, by a vote of 40 to 18. The ordinance was introduced some time ago, but was so strongly opposed that it was placed on file. At latest accounts the mayor had not approved the ordinance. Further information regarding the efforts to introduce Waukesha water in Chicago and at the Columbian Exposition, together with a description of the 104-mile pipe line, is given in Engineering News of March 19, 1892, and Jan. 12, 1893.

The new project for the completion of the Transandine Railway was noted in our issue of March 16, and according to an English paper, the examination of the works has been satisfactory, and a scheme has been devised by which the completion of the line may be very materially accelerated. The original project involved the construction of some tunnels of considerable length, the longest being two of 3 and 2½ miles respectively. The proposals of Mr. Baggallay, the engineer, provide for shorter tunnels, saving time in construction. It is also proposed to carry on the tunneling operations by manual labor, instead of electrical machinery. It is anticipated that the works remaining to be completed might be finished in about 2½ years, and the completion of the line would permit of the journey from Buenos Ayres to Valparaiso being done within three days. Mr. Baggallay is of opinion that the line might be expected to keep open throughout the entire year, although the mountain section will always be liable to interruption during the winter season from snowslides. It is hoped it will be practicable to obtain in London the capital requisite for carrying on the works to completion without further delay. About 44 miles of line remain to complete the connection between the railways in Argentina and Chile.

A combined storage battery and axle-driven dynamo system of electric car lighting has been developed by Messrs. Samuel Young and Morris Muskowitz, of Newark, N. J., and has been applied to a passenger car on the Central R. R. of New Jersey. An exhibition run was made from Newark to Roselle on April 21. The dynamo is automatically controlled, and the inventors claim that they will yet be able to dispense with an attendant on the train, the cost of which is a large item in the expense of electric train lighting.

A system of sewerage and sewage disposal is to be constructed at Cape Town, South Africa, and proposals will be received until July 29, by W. Brownehead, Town Clerk. There will be 223,910 ft. of 9, 10, 12, 15 and 18 in. sewer, 15,189 ft. of high level intercepting and outfall sewers from 15 ins. to 4 ft. 6 ins. diameter, 132,000 ft. of 6-in. and 9-in. house connections, and 6,218 ft. of 30-in. and 36-in. surface water culverts of concrete and stone; altogether 377,317 ft., or 71½ miles. There will also be 12,200 ft. of 22-in. cast iron pumping main, together with manholes, ventilation and inspection shafts, flushing and valve chambers, engine and boiler house, hydraulic pumping engine station, etc. Plans may be seen and information obtained at the offices of the City Engineer, Cape Town, and of Mr. Clement Dunscombe, M. Inst. C. E., 32 Victoria St., London, England.

The most serious railway accident of the week was a collision on the Bare Rocks R. R., near Somerset, Pa., April 25. The line is a short one, running to a large stone quarry, and has a grade of nearly 3%. A train of stone cars ran away in descending this grade and collided with a number of loaded stone cars at the bottom. Five persons were riding on the engine, and a number of laborers were on the runaway cars. Eight or ten persons were killed and others injured by the collision or by jumping from the cars.

Another recent serious railway accident was a rear collision, April 17, near Farwell, Mich., on the Toledo, Ann Arbor & North Michigan Ry. A work train had been sent out to remove some wrecked cars, and no flagman was sent out. A passenger train ran into the caboose of the work train, killing three men and injuring three more.

The bridge over Sugar Creek, near Crawfordsville, Ind., on the Louisville, New Albany & Chicago Ry., which was wrecked by being struck by a derailed freight car April 12, as noted in our issue of April 20, was an iron structure; one span went down and the adjoining span was injured; the engine and two cars passed over in safety, but 15 cars went down. Other bridge accidents are reported as follows: The falseworks of the Pacific Short Line Ry. bridge at Sioux City, Ia., were badly damaged by a flood April 10. Highway bridges over Rock and Plum creeks near Kimswick, Mo., were washed away April 14. A wooden bridge over Sandy Creek on the Lake Shore & Michigan Southern Ry. was burned April 15, and a new iron bridge will be built. The Great Northern Ry. bridge over the Clearwater River near Red Lake Falls, Minn., was carried away by ice on April 18. The viaduct between Peoria and East Peoria was washed away April 21. A wooden bridge or trestle on the Mexican National Ry., near Mariposa, was burned by train wreckers April 21, but the trains were warned by sectionmen. A large bridge over Hangman Creek, near Latha, Wash., was carried away by floods April 6.

A bridge accident on the Louisville, New Albany & Chicago Ry., near Rossville, Ind., April 8, was noted in our issues of April 13 and 20, and we are indebted to Mr. S. J. Collins, General Superintendent, for the following particulars:

The accident at Rossville, Ind., on April 8, was occasioned by an obstruction upon the track. The obstruction was on a steel plate-girder bridge, which derailed the engine, running it into a Howe truss bridge, which was partly in use. The height of the bridge was 22 ft.; length, 125 ft.; one span; material of Howe truss, wood; age, 12 years. We had lately put in two steel girders, which replaced one Howe truss span of 125 ft., and partly supported the second span, which was torn down by the wreck. The span was torn down on account of engine leaving the track and going through the bridge. No one was killed. The engineer and fireman were injured, but no passengers injured. The engine will require a general overhauling. The trucks of the baggage car and two coaches were badly damaged, but the bodies of the cars were only slightly injured.

The severe storm which swept over Lake Michigan April 19 and 20 wrecked the temporary building on the crib of the Milwaukee water-works intake tunnel, now under construction, and caused the death of 14 out of 15 men who were in the crib. It appears that about 10 p. m., April 19, the men took refuge from the storm in the upper air-lock of the shaft. At 6 a. m., April 21, water began to enter the lock from below, partly, at least, on account of the stoppage of the pumps, and at 8:30 a. m. the air in the lock became so bad that the 15 imprisoned men decided to go to the surface, evidently not knowing that the building had been carried away and that the waves were sweeping over the crib. Upon opening the trap door of the lock the water rushed down, so that only six men reached the platform, and all but one of these were swept off the crib and drowned before the lifeboat reached them. The damage to the crib is said to be about $10,000. The new intake was described and illustrated in Engineering News of Oct. 25, 1890.

A heavy storm of wind and rain caused some considerable damage at the World's Columbian Exposition, but the damage was mostly of a minor character. Scaffoldings and slight structures were blown down, and some of the "staff" covering suffered. The wind blew the rain through all the crevices of the buildings, and through the skylights and windows, damaging some of the exhibits, especially in the Government Building.

The storm of April 20 broke down the dams separating the excavation for the Harlem River ship canal from the Spuyten Duyvel Creek and Harlem River. These dams were 350 ft. long, 60 ft. wide at the base and 30 ft. wide at the top, and rise 4 ft. above ordinary high-water. The stiff northwest wind backed up the water in the river and creek until at flood-tide the rise was 12 ft., and both dams broke. The cut is 32 ft. deep, and Contractor Denniston, of the firm now doing the work, estimates that it will take over three weeks to repair the dams and pump out the 75,000,000 gallons of water now in the cut.

Experiments in propelling canal-boats by electricity are to be made on the New York state canals, the legislature having appropriated $12,000 for that purpose. As water-power could be secured for generating the necessary current at many points, and the water of the canal itself would furnish a costless and well-nigh perfect ground return for the current, the experiment seems to have much promise of success.

The steady abandonment of the second-class accommodation on English railways, noted in our issue of April 13, has made a marked advance, the London & Northwestern Ry. and the Caledonian Ry. having decided to discontinue the second-class on the trains running jointly over their lines between stations in England and Scotland. This arrangement will go into effect May 1.

The large steel highway bridge at Portland, Ore., being built to carry Burnside St. across the Columbia River, will be 1,621 ft. long and 46 ft. wide in the clear. The bridge proper consists of two fixed spans 302 ft and 242 ft., respectively, and a swing-span of 385 ft., and will carry a 36-ft. roadway and two 7-ft. sidewalks. On the east side there is a wooden trestle-work approach, 692 ft. long, and on the west side an earth embankment and trestle-work approach of 190 ft. The swing-span will be operated by steam-power. The foundations of the pivot pier consist of a steel cylinder, 43 ft. in diameter, resting on a grillage of 12 × 12 ins. timber 41 ft. thick, supported by 300 piles driven to bed rock. The cylinder is made of ½-in. steel plates, and is filled with concrete. On the top of the cylinder is the masonry pier, 33 ft. high and 42 ft. in diameter, surmounted by a heavy stone coping. The facing is of cut ashlar, in 20-in. courses, and the backing of coursed rubble. The diameter of the drum supporting the swing-span is 39 ft., and it rests on 60 cast steel wheels traversing a circular steel track. The east abutment is a platform pier, consisting of a grillage 6 ft. deep, 16 ft. wide and 52 ft. long, which rests upon 83 piles. Above the grillage rest 29-ft. steel cylinders, which carry the bridge. The piers on either side of the pivot pier consist of steel cylinders 14 ft. in diameter, surrounding clusters of 18 piles. The pairs of cylinders are thoroughly braced together with lattice bracing and plates, the space between low and high water being a solidly-braced plate. These cylinders are let into the ground from 6 to 10 ft., and within them about the pilling strong concrete is deposited. The west abutment pier consists of 9-ft. cylinders surrounding clusters of 12 piles, and filled with concrete. The bridge will be 40 ft. above low water and 14 ft. above extreme high water. Its cost will be $300,000.

"MAXIMITE," A NEW EXPLOSIVE.

A test of a new high-explosive called "Maximite," was made April 21 near the corner of 138th St. and Madison Ave., New York, where a rock bluff is being cleared to street grade to make a level site for building or manufacturing purposes on the block fronting on the Harlem River. Ordinary 60% dynamite is being employed on the work, but for the trial blast the holes were charged with maximite cartridges aggregating 80 to 90 lbs. of explosive, while a charge at least one-fourth heavier of dynamite would have been used. The blast was entirely successful, shattering the lower portion of the rock, blowing outward the face of the bluff (probably several hundred tons) and showing its power by raising into the air a bowlder estimated to weigh 50 tons, which lay on the edge of the bluff over the blast. There was no smoke, and but slight fumes were noticeable. Among the persons present were Hudson Maxim and several officers of the Columbia Powder Mfg. Co.; John Claffy, of the contracting supply firm of John Claffy's Sons, New York; J. P. Sullivan, contractor for the clearing work on which the trial was made; Clinton Stevens, contractor for the Tilly Foster iron mines, New York; P. H. Brink, an expert on explosives; Col. W. H. Gilder, J. G. Macbeth, manufacturer of electrical supplies; E. E. Russell Tratman, Associate Editor of Engineering News, and other persons interested.

The explosive is the invention of Mr. Hudson Maxim, of New York, and is a nitro compound, the base being guncotton, but the ingredients and process of manufacture are a trade secret. The inventor has been experimenting with smokeless rifle powders for about four years, making a specialty of nitro compounds, and has been very successful in this direction. In these experiments he found that the compound could be made so cheaply that it could compete with dynamite, and he could therefore make, with the guncotton, a smokeless explosive for blasting. The experiments with this explosive have been in progress for about a year, and the material is now successfully manufactured and costs no more, for the same amount of work, than dynamite. It is claimed that 10 oz. of maximite are equal in effect to 1 lb. of 40% dynamite. In a smokeless powder it is necessary that the products of combustion shall be entirely gaseous, and in this material the products are mainly carbonic acid gas and water.

Another special feature of this explosive is that it is unfreezable, and this feature is one of great importance, as pointed out in an article on "Unfreezable Dynamite," in our issue of March 2. A bottle of the liquid nitro compound, not made up with guncotton, after immersion in a freezing mixture, was buried at one side of a rock and successfully exploded. The ordinary exploders are used. It is also claimed that one cartridge cannot be exploded by the explosion of another standing beside but not touching the first; that the material is difficult to set fire to, and that it cannot be exploded by striking with a hammer, while a temperature of about 400° is required to explode it by direct heat. It can be used for quarrying by packing the cartridges lightly so as to prevent the shattering effect required in mining and other ordinary blasting. The cartridges weigh about 14 ozs. and are used in competition with the ordinary 1 lb. dynamite cartridges.

Maximite is claimed to be equal in power to pure nitro-gelatine or nitro-glycerine, weight for weight, and the comparative power of different explosives is shown in the following table, the unit being black blasting powder:

Black blasting powder	1
Dynamite, ordinary 40%	9
Dynamite No. 1, 75% nitro-glycerine	13
Gun-cotton	14
Nitro-glycerine	16
Blasting gelatine (nitro-glycerine)	17
Maximite	17

This explosive is being introduced by the Columbia Powder Mfg. Co., of New York, which has a plant at Farmingdale, N. J., for manufacturing ordinary dynamite. The company is enlarging its facilities and will devote its attention mainly to the new explosive, which it expects will largely supersede dynamite. In a few weeks the plant will have a capacity of five tons a day. The company has a capital stock of $250,000. President, Beverley R. Codwise; Vice-President and General Manager, F. Laflin Kellogg, President of the Phoenix Powder Co. (whose works are also at Farmingdale); Chemist and Engineer, Hudson Maxim. The company is shortly to be reorganized as the Maxim Powder Co. of America, with a capital stock of $500,000. The explosive and the processes of manufacture are patented in this country and abroad. The offices of the company are at 280 Broadway, New York, N. Y.

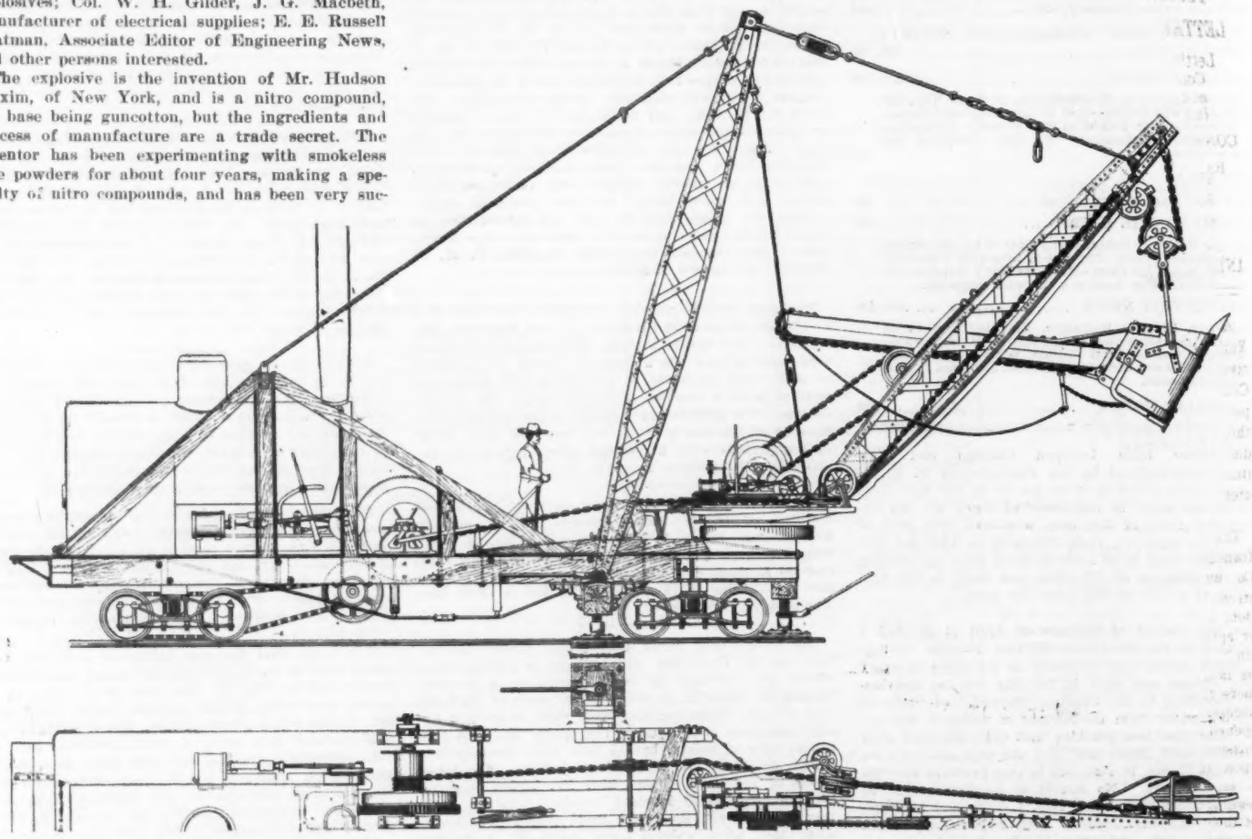

FIG. 1. ELEVATION AND HALF PLAN OF OSGOOD STEAM SHOVEL; OSGOOD DREDGE CO., ALBANY, N. Y.

INCANDESCENT LAMP PATENTS.

The first step toward declaring the Edison patent on the incandescent lamp invalid was taken at St. Louis, April 20, when Judge Hallett, of the United States Circuit Court, handed down a decision denying the preliminary injunction against the Columbia Incandescent Lamp Co. asked for by the Edison Electric Light Co. For many years the validity of the Edison patent on the incandescent lamp has been in litigation, the contending parties being the owners of the Edison patents and the Westinghouse Electric Co. The decisions in this litigation, both in the Circuit Court and in the Court of final resort, the last rendered in August, 1892, sustained the Edison patent. The owners of the Edison patents then applied for injunctions against the smaller lamp manufacturers, and it was supposed that no opposition would be made to the issuance of these injunctions. But after two or three concerns had been closed, the Beacon company, of Boston, opposed the motion for an injunction to stop the operation of its plant and presented evidence showing that the incandescent lamp was invented and put in public use by one Henry Goebel, years before Edison or any other inventor attacked the problem. A full statement of this litigation was given in our issue of Feb. 2. Its final result was the granting of the injunction by Judge Colt on the ground that the evidence sustaining Goebel's claim to be the original inventor was insufficient.

The Edison people then applied for an injunction against the Columbia Incandescent Lamp Co. and the Goebel matter was brought up anew. Its presentation in the Beacon case was hurried and incomplete on account of lack of time; but in the Columbia case a large amount of additional evidence was brought in in support of Goebel's claims, and the case was most thoroughly argued on both sides. As a result Judge Hallett has refused to grant the injunction asked for.

The importance of the decision is very great, not only to the manufacturers of incandescent lamps, but to the electrical interests everywhere and to the general public. Of course this is merely the first engagement in what promises to be a hard fought battle. As the preliminary injunc-

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The first railway in Siam, from Bangkok, the capital city, to the port of Paknam, at the mouth of the Menam River, was opened April 11. The first sod was turned in July, 1891, and the line is about 20 miles long.

tion is refused, the case must now be heard on its merits in the Circuit Court, and afterward, probably, in the Court of Appeals. Meanwhile the Columbia company and other makers of incandescent lamps against which injunctions have not been secured will go on with the manufacture, and even in the event of a final victory by the Edison interests the delay in securing it will probably be such that the patent will then be nearly or quite at the end of its life. It expires in November, 1894.

The vital importance of the decision to the electrical interests arises from the general belief that the owners of the Edison patent intend to use it to control trade in every branch of electrical work. Every electric company must have a supply of lamps, and if this supply is a monopoly in the hands of a single company then that company can legally refuse to sell lamps to those who purchase dynamos, motors or other apparatus of competing companies. The belief that the General Electric Co., which owns the Edison patent, proposes to use it as a club to knock out competition in every other branch of electrical industry has aroused the enmity of many who would be glad to see the patent sustained if it were used only to collect reasonable royalties from makers and users of other incandescent lamps.

Besides the chances that the Edison patent may be finally defeated on the ground of Goebel's anticipation, several new lamps are in the market or in the hands of inventors, which are claimed not to infringe the Edison patent. Besides the Westinghouse lamp, which has been already described in these columns, the Star Electric Lamp Co., of Chicago, has brought out a lamp having an inert gas inside it, instead of a vacuum, which is claimed to be superior in efficiency and life to the vacuum lamp. Besides this, several inventors are at work on "stopper" lamps, which can have their filaments replaced when broken. The Westinghouse was the first lamp of this type on the market, and the manifest advantages make it not unlikely that lamps of this type may yet replace the familiar type covered by the Edison patent.

Of the several proposed electric underground railways for London, the bill for one from the city to the Waterloo Station of the London & Southwestern Ry., on the south side of the Thames, has been passed by a committee of the House of Commons, while the same committee has rejected the bill for a line from Clapham Junction in the south, to the Paddington Station of the Great Western Ry. in the west of London. The former line will have no intermediate stations, and will be about 70 ft. below the bed of the river.

STEAM SHOVELS AND STEAM SHOVEL WORK.*

By E. A. Herrmann, M. Am. Soc. C. E.

Part I.—Steam Shovels.

The following article originated in a short paper which was read before a local society of civil engineers, and there were so many requests made for this paper and the illustrations presented with it that the author was led to believe that there was a demand for such information. Believing that a better understanding of the capabilities of these machines will serve a useful purpose in economizing money, time and labor in the execution of work to which they are adapted, the author presents in this article the information learned by a long practical experience in this special class of work. Descriptions of the various steam shovels can readily be found in the trade catalogues of the different manufacturers, but very little has been published on the manner of using them in the execution of different classes of work, and the disposition of the excavated material after it has been loaded on cars or wagons. This part of the subject will receive most attention, and although much of it may seem very elementary to those who have had an extended experience in operating steam shovels, it may be entirely new to the much larger number who have had few or no opportunities for doing work of this kind. It has been the aim of the author to condense the reading matter as much as possible, making it a point to use many illustrations in place of lengthy explanations, thus presenting the subject more clearly than by extended descriptions.

The steam shovel, or steam excavator, is a modified form of dredge adapted for excavating material on dry land. It was designed and patented by a Mr. Otis, about 1840, and like most new inventions the first machine built was a very clumsy affair, but even in this crude state it possessed many advantages for removing large masses of material. Its merits were recognized in its earliest stages, and with increased experience in its operation improvements were soon made which rendered it almost indispensable on all works requiring large quantities of excavation.

It was not until 1865, however, that the machine came into general use. About this time the largely increased railway construction created an active demand for the steam shovel, which demand was quickly supplied by several manufacturers, whose machines vary in distinctive designs of various parts, but the principles of operation are essentially the same in them all.

Types of Steam Shovels.—There are three types of steam shovels: First, machines mounted on trucks of standard gage, transported from place to place in freight trains (or propelled by their own power), and intended for railway work only. Second, machines mounted on wheels of other than standard gage, transported in sections by boat or wagon, or loaded complete on flat cars, and intended for both railway and other work. Third, machines mounted on wheels fitted for transportation over common roads, propelled by their own power, and intended for railway and other work.

The first machines built were of the second type. As now constructed they are mounted on a wide wooden frame or car body, supported by four small wheels of 7 ft. to 8 ft. gage, thus placing the machinery close to the ground, with a wide base of support. In transporting this machine from one place to another, not on the line of a railway, it is necessary to take it apart, forward the sections and put them together again at the site of the new work. The machine is built with a view to rapid dismantling and re-erection, and for work requiring a large machine for economical excavation, located in hilly country not yet made accessible by rail, or requiring transportation by boat, it is the machine most generally used. Its ready adaptability to all kinds of work in any location has made it the favorite machine with many general contractors whose work includes large contracts for railway and other excavation. For transportation by rail this machine is run onto an ordinary flat car, only the crane being detached and loaded on a separate car. With this manner of shipment the machine can be made ready for railway work very quickly, but for exclusive railway work a machine of a later design has come into use and is now generally preferred for this class of work.

This is the machine of the first type, resting on a wooden or iron car body, supported on trucks of standard gage, with an iron or steel crane from 18 to 26 ft. high over the track when in working order,

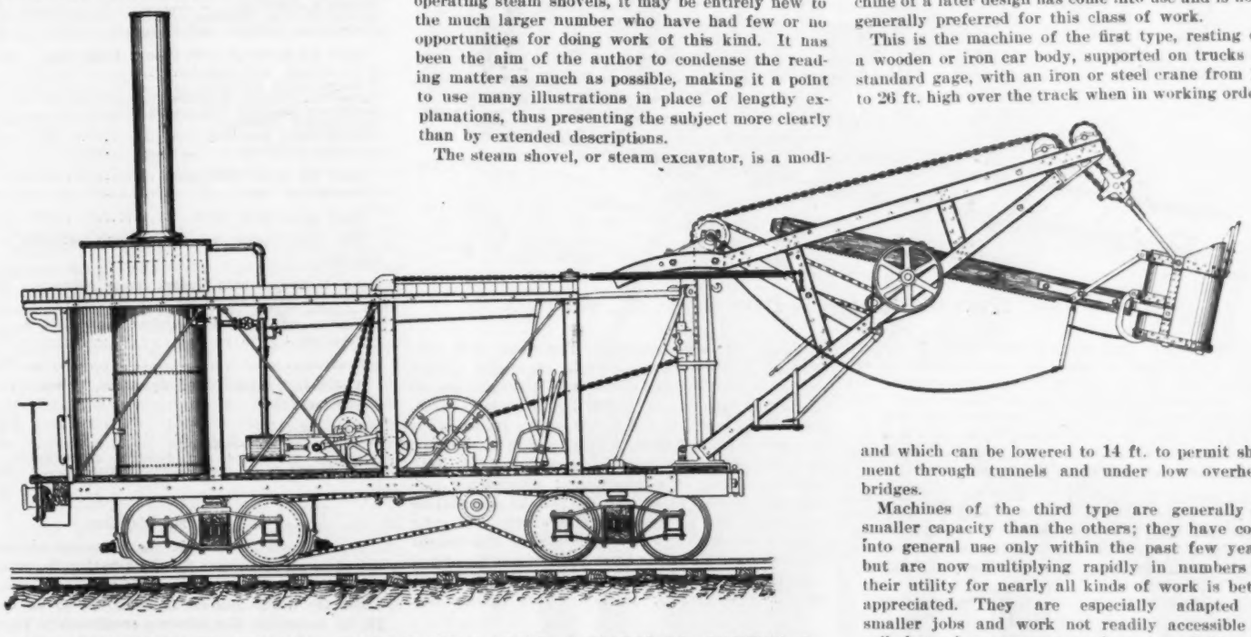


FIG. 2. THOMPSON STEAM SHOVEL; BUCYRUS STEAM SHOVEL & DREDGE CO., BUCYRUS, O.

and which can be lowered to 14 ft. to permit shipment through tunnels and under low overhead bridges.

Machines of the third type are generally of smaller capacity than the others; they have come into general use only within the past few years, but are now multiplying rapidly in numbers as their utility for nearly all kinds of work is better appreciated. They are especially adapted to smaller jobs and work not readily accessible by rail, but where common roads are available.

These three types are shown in Figs. 1 to 9, representing the machines of seven of the principal manufacturers.

Steam shovels will excavate any kind of material except solid rock, and they will load rock if it has been broken up by explosives into pieces of not more than ¾ cu. yd. in size. The materials excavated by them are mostly sand, loose gravel, all kinds of clay, cemented gravel, hard pan, clays mixed with bowlders and other small stones, ore, phosphate rock, loose rock and thin seams of slate, shale or sandstone

These machines are used for excavating material, loading it on cars or wagons for ballasting tracks; for filling trestles, streets, roads, dams, lots and new city additions; for widening embankments for double track, side tracks, yards, shops and station grounds; for cutting down street, road, and railway grades; grading lots and new city additions, railway yards, shop and station grounds; widening cuts, removing land slides, stripping coal fields, ore beds and stone quarries; digging canals and drainage ditches, loading clays for brick yards, etc.

Construction of Steam Shovels.—The general plan of construction of the machines, shown in Figs. 1 to 9, is essentially the same in all, and consists of a strong frame, mounted on wheels, forming the base to which all working parts are attached. The boiler and machinery are placed near the rear end of the frame, and the mast, or post, and crane at the front end. The crane is made in two pieces connected only at the top or point, and at the foot of the mast. Between these

* Copyright, 1893.

pieces, serving as guides, is the dipper handle, carrying at its farther end the dipper or scoop. To the top of the post (or to the foot in some machines) the swinging circle is secured.

(To be continued.)

The Long Island Water Supply Co.'s case is up again in the Brooklyn Supreme Court for the settlement by Judge Pratt of his decision setting aside the late commission's award of $570,000 as full compensation for the property and rights of the company. Counsel for the company want an order made formally setting aside the award, and appointing a new commission. Counsel for the city oppose the appointment of a new commission, as under the amended law an appeal would be taken to the Court of Appeals. The company's attorneys answer that the new law makes it optional with Judge Pratt to hand the case back to the old commission, or to appoint a new commission, and he had already determined on the latter course. The question was also argued whether the Judge who decided the case or the General Term, to which the case was appealed, should appoint the new commission. Judge Pratt has reserved his decision.

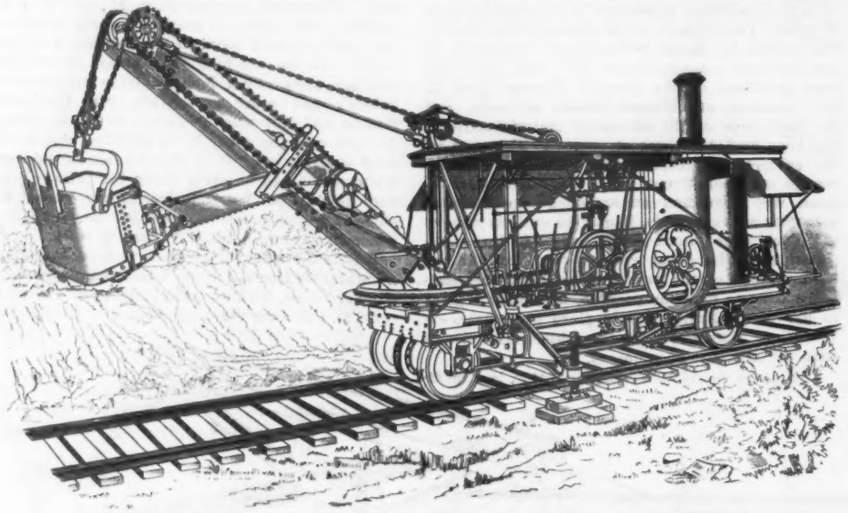


FIG. 3. BARNHART STEAM SHOVEL; MARION STEAM SHOVEL CO., MARION, O.

An alternative outlet to the Gulf for the commerce of New Orleans is again asked for by the press of that city; and they urge the passage of the bill already introduced in Congress providing for the improvement of the Southwest Pass. This was the pass originally preferred by Captain Eads, as giving a wider channel and greater depth, and the late grounding of the English steamer "Gerona," drawing 24 ft. aft, and the possibility of a similar accident blocking the traffic through the South Pass, has called renewed attention to the advisability of having two openings to the Gulf.

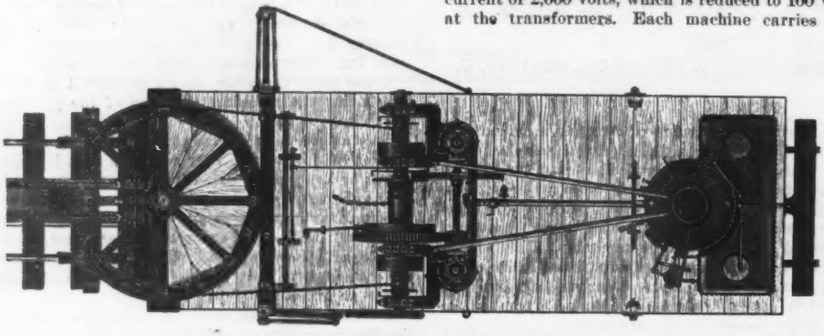


FIG. 4. PLAN OF BARNHART STEAM SHOVEL.

The British states in India, according to Mr. Baines, the Census Commissioner for India, cover an area of 965,000 sq. miles, while the fendatory states include 595,000 more, or a total area of 1,560,000 sq. miles. The population of British India is 221,173,000, and the native states include 66,050,000 more, or 287,223,000 in all. The average density of population over all India is 184 to one square mile. This is a pretty big country for about 38,000,000 Englishmen, Scotchmen and Irishmen to control.

WORLD'S COLUMBIAN EXPOSITION.—IX.

Incandescent Electric Lighting.

The electric lighting of the buildings and grounds has been provided for on a most liberal scale, both for necessary illumination and decorative effects, and it is estimated that there will be 8,000 arc lamps of 2,000 c. p. and 120,000 incandescent lamps of 16 c. p. The arrangements have been described in our issues of Jan. 16, March 12, May 26, June 9 and July 21, 1892, and we take the following particulars as to the incandescent lighting from an article in "World's Fair Electrical Engineering," by Mr. R. H. Pierce, Chief Electrical Engineer, who, with Mr. F. H. Sargent, Electrical and Mechanical Engineer (who resigned recently), designed the arrangements. The plant will consist of a 2,500-HP. quadruple expansion Corliss steam engine, driving direct two Westinghouse alternating dynamos of 10,000 lights capacity each, two 72-in. belts, one over the other, transmitting the power from a 30-ft. driving pulley to the 9-ft. dynamo pulleys. There are also ten 1,000 HP. engines driving ten 10,000-light alternating current machines, while two 4,000-light alternating machines and necessary exciters are driven by engines of less capacity. The twelve 10,000-light machines are all of the same pattern and furnish a current of 2,000 volts, which is reduced to 100 volts at the transformers. Each machine carries two 5,000-light armatures upon the same shaft and can be operated as two independent machines. They are rated at 10,000 lights each, but have shown, in tests, a capacity of 15,000 lights of 16 c. p., so that the total rated and actual capacity of the 14 Westinghouse alternating dynamos is 140,000 and 158,000 lights respectively, of 16 c. p.

The switchboard is of white marble panels in an iron frame 76 ft. long, and to it are brought all the leads from the dynamos and exciters. The conductors are of lead covered Waring cable, carried upon iron brackets with insulated fiber bushings. From the switchboard the feeders, of similar cables, are carried to a fireproof room containing the lightning arresters, and thence to the subways. The main trunk line alone comprises over 76,000 ft. of duct, and in the whole system over 225,000 ft. of duct have already been laid. The main subway contains about 25 miles of feeders, and the ducts carry over 40 miles of duplex cable. The contract with the Westinghouse Electric & Mfg. Co. for incandescent lighting called for dynamo, feeder and converter capacity for 83,410 lamps of 16 c. p. and 6,212 lamps of 10 c. p., or a total of 89,622 lamps; and inside wiring or wiring to lamps for 50,410 lamps of 16 c. p. and 6,212 lamps of 10 c. p. or 56,622 lamps. The estimated distribution has been substantially carried out for the buildings lighted exclusively by incandescent lamps for the decorative arrangements, but many additional buildings have had to be provided for. There will be ample capacity to supply all lights desired for the exhibits and concessions. The decorative lighting is limited to the outlining of the Grand Basin and of the Administration Building, lights in flower beds, and the lighting of the Wooded Island in the lagoon by 25 c. p. lights placed along the walks and at the seats. The estimated distribution was as follows, the first four buildings being lighted exclusively by incandescent lamps, and the others by incandescent and arc lamps:

	Lights.
Fine Arts Building and annexes	16,242
Woman's Building	3,000
Administration Building	5,000
Music Hall, Peristyle and Casino	4,368
Total for buildings with incand. lamps only	28,610
Horticultural Building	800
Transportation Building	2,500
Mines and Mining Building	3,000
Machinery Building and annex	1,000
Agricultural Building	4,000
Manufactures Building	10,000
Fisheries Building	500
Total for main buildings	21,800
Decorative lights	6,212
Total lights to be used	56,622

The distribution for the various purposes is as follows:

	Lights.
Inside buildings, with incand. lamps only	25,918
Decorative lights on exterior of buildings	5,442
Decorative lights on grounds	6,212
Lights in office and for exhibitors and concessionaires	19,050
Total	56,622

Additional capacity of dynamos, primaries and converters:

	Lights.
Service Building	1,500
U. S. Government Building	5,000
Buildings of states and foreign governments and buildings on the Midway Plaisance	26,500
Total	33,000

Arc Electric Lighting.

From another article in the magazine above referred to we learn that for illuminating the grounds and the entrances to the buildings there will be 1,550 arc lamps placed at intervals of 65 ft. to 75 ft., except in the extreme southeastern part of the grounds, where the distance will in some cases be 125 ft. Clusters of lights will be placed at the entrances to the main buildings. The lamps will include all the standard makes, both single and double carbon, supported on ornamental posts (for exterior illumination) for one, two or three lamps, and having arms to carry incandescent lamps of high power inclosed in colored glass lanterns. About 10% of the lamps are on the patrol circuit and will be lighted from sunset to sunrise. The ornamental posts are set at equal distances on each side of the walks, and about 40 ft. from the main buildings. In the Midway Plaisance the lamps will be placed opposite one another on each side of the main avenue, at intervals of 75 ft. The bridges over the lagoons (Eng. News, April 21, 1892) will have three-light clusters in the middle and single lamps on the approaches. Along the high boundary fence and in the outlying parts of the grounds plain cedar posts are used, with ordinary lamp supports.

Arc lights will also be used for interior illumination in the main buildings. In the great Manufactures' Building (Eng. News, July 28, Sept. 1 and 8, 1892), five circular electroliers, built up of angle iron, will be suspended from the main trusses, the lamps being about 140 ft. above the floor and 40 to 70 ft. below the roof. Four of these will be 60 ft. diameter with 76 lamps, and the center one will be 75 ft. diameter with 100 lamps. The lamps will be in a double circle. The lamp trimmers will ascend the main trusses and then descend by a ladder, the circle and the bridge across it having foot-

paths and handrails. The glass dome of the Horticultural Building (Eng. News, March 12, 1892) will be lighted by three circles of lights, one above the other, the upper having 10 lamps and each of the lower circles 20 lamps. The number of lights for interior illumination is about as follows:

	Lamps.
Manufactures Building	1,200
Agricultural Building and annexes	500
Transportation Building	350
Machinery Building	250
Horticultural Building	250
Mines and Mining Building	200
Fisheries Building	50
Illinois State Building	77
Total for interior illumination	2,877
Total for exterior illumination	1,550
Total number of arc lamps (inclusive of exhibits)	4,427

All of these will be supplied with current from the main power plant of the Exposition, and in addition there will be over 250 in the Machinery Building, supplied under a special contract by a few of the leading exhibitors, who will also supply the arc lights in the Transportation annex, the Forestry Building, the Choral Building and the pumping station. Many of these extra lights will be furnished by the Standard Electric Co., the Western Electric Co. and the Fort Wayne Electric Co., all of which have installed dynamos for this purpose.

Tickets.

The American Bank Note Co. has a contract to furnish 6,000,000 admission tickets next summer. They are about the size of the old 25 ct. "shinplasters." There are four styles of tickets, each of which calls for a single admission at any time during the Exposition. The backs of the tickets are plain, but the fine engraving of the words "Columbian Exposition, Chicago," is a proof against counterfeiting. Another safeguard against counterfeiting is the use of a strip of localized planchettes running through the ticket, being dots of four different colors. This is the first time paper with these planchettes has been used. The Walmsley automatic registering turnstile and ticket-chopper will be used at the gates, each gate operated by a single person. The visitor drops his ticket in the box, and as the stile turns the ticket is automatically notched in five different places on the edges, the mutilation being so pronounced as to prevent the possibility of fraudulently fixing up the tickets to be used over again.

Historical Locomotives and Cars.

Among the historical railway exhibits will be the locomotive "John Bull" and two cars of the Camden & Amboy R. R., and an exact reproduction of the locomotive "DeWitt Clinton" and three cars of the Mohawk & Hudson R. R. The "John Bull" was built at Newcastle, England, in 1831, at the works established by George Stephenson, and still in existence, though behind the times and doing little business. It was shipped in pieces, arriving in this country in August, 1831, and was put together at Bordentown, N. J., by Isaac Dripps, who afterward ran the engine. Several alterations were made during its service, a headlight was added, and a pilot or cowcatcher which was carried by two small wheels, forming a pony truck, as described and illustrated in our issue of Jan. 18, 1890. The tender was like a short four-wheel box car, with the roof extended over the open footplate, and a seat for a brakeman at the rear end of the roof. The engine had four wheels, 4 ft. 6 ins. diameter, one pair being the driving wheels, with a crank axle. The cylinders were inside, 9×20 ins. The wheels had cast iron hubs, wooden spokes and rims, and wrought iron tires ¾-in. thick. The boiler carried 30 lbs. pressure. The engine was exhibited at the Centennial Exposition at Philadelphia, in 1876, and at the Exposition of Railway Appliances at Chicago, in 1883, after which it was presented by the Pennsylvania R. R. to the U. S. National Museum, at Washington. In arranging for the exhibit at the World's Columbian Exposition the Pennsylvania R. R. decided to include the "John Bull," which it borrowed from the government, and also secured two of the old passenger cars of the Camden & Amboy R. R., which were built in 1831, and have been repaired and put in the condition in which they were in service. They are 30 ft. long inside, carried on four-wheel trucks, and have end platforms and steps, elliptical roofs, and seats for 40 passengers, the seats being arranged as in the ordinary American car of to-day. The engine was overhauled at the shops, the boiler repaired and fitted with new tubes, and tested to 120 lbs. pressure. It was decided to run the engine to Chicago on its own wheels and under its own steam. It left New York April 17, and arrived at Chicago April 22. The tender and two cars were attached and a number of prominent railway men rode on the train over different parts of the route.

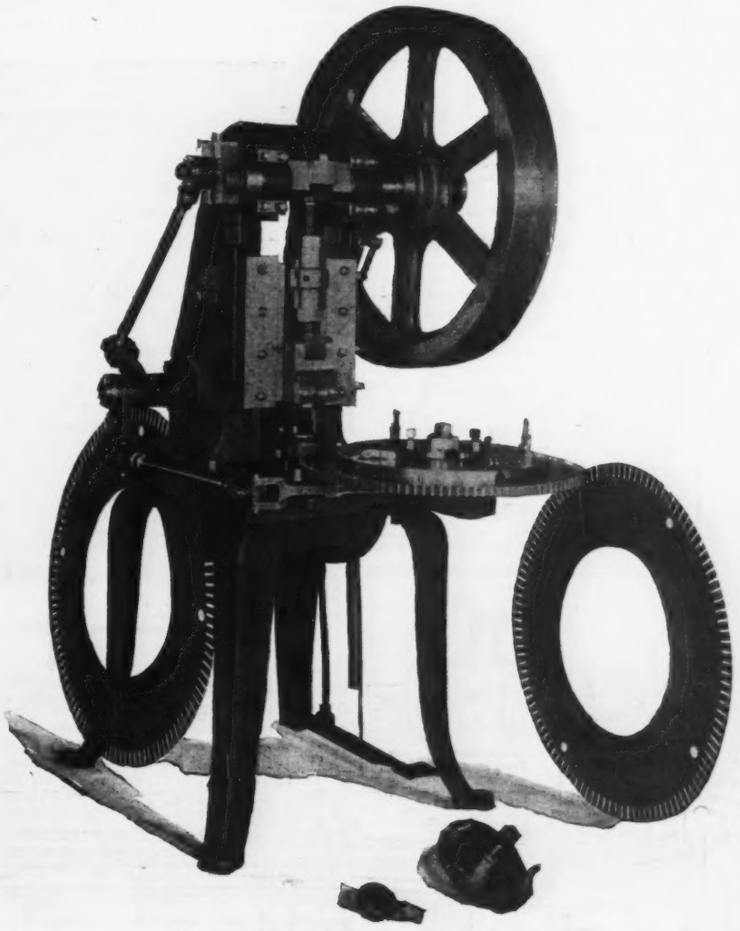
The "DeWitt Clinton" was built at the West Point Foundry in 1831, for the Mohawk & Hudson R. R., and hauled the first passenger train in America on Aug. 9, 1831, from Albany to Schenectady, N. Y. The cars were stage coach bodies attached to four-wheel platform cars, and having seats inside and outside. The engine had cylinders 5½×16 ins., four wheels 4 ft. 6 ins. diameter, and weighed about five tons. The cars were built by James Goold, and we take the following abstract of the specifications from the New York "Tribune":

I propose and agree to furnish for said railroad company six coach tops—to furnish jacks, and jackbolts, and braces, with thorough braces, and put them on the frames of the company's railroad carriages to support the coach tops; the coach tops to be finished and hung in the style of workmanship generally adopted in Albany and Troy for post coaches. The materials and workmanship to be first quality; a baggage rack and boot to be hung at each end. The length of coach body to be 7 feet and 4 inches—5 feet wide in the center, and 3 feet 8 inches between the jacks. The general plan of the coach to conform to the plan and explanation given by the engineers of the company. To have three inside seats, the backs of the end seats to be stuffed with moss—and all the seats to be stuffed with hair—to have a door at each side—to have an outside seat on each end across the top of the coach with suitable foot-board: also a seat at each end for driver or brakeman, to drop below to a suitable height to make the rack his foot-board. An oil cloth to be rigged to the center rod on coach top to cover baggage, and one at each end rolled to the back of the seat to protect it from rain."

A reproduction of this locomotive has been built by the New York Central & Hudson River R. R., and will form a part of that railway's exhibit, together with three of the cars. As a contrast to this little 5-ton engine, there will be a 62-ton eight-wheel engine of the latest express passenger type, with driving wheels 7 ft. 2 ins. diameter, built at the company's shops to the designs of Mr. William Buchanan, Superintendent of Motive Power. The very comprehensive exhibit arranged by the Baltimore & Ohio R. R. will include reproductions of a number of other old American engines.

PRESS FOR NOTCHING ARMATURE DISKS.

With the rapid extension in the use of electrical machinery which is all the time in progress, special tools for its manufacture are reaching a high state of perfection. We illustrate herewith a recently designed stamping press for notching armature disks which has been brought out by the E. W. Bliss Co., of Brooklyn, N. Y. Its operation will be evident from the engraving. The punching slide is driven by an eccentric on the main shaft at the top of the machine. The disk to be punched is clamped to the revolving horizontal plate, which is given a step-by-step movement by a ratchet wheel on its under side, driven by link work from a small eccentric on the end of the main shaft. The operation is controlled by a treadle which operates a friction clutch on the main shaft, and starts the feeding and punching movement simultaneously. The machine will notch disks from 10 ins. to 34 ins. in diameter. Its weight is about 1,700 lbs.



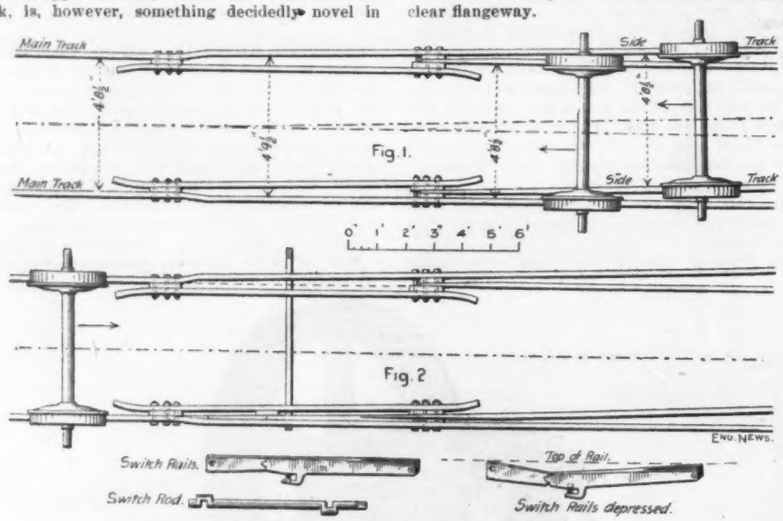
BLISS PRESS FOR NOTCHING ARMATURE DISKS.

Plans for submarine torpedo-boats are called for by the Ordnance Bureau of the U. S. Navy Department. These boats are to be of about 125 tons displacement, with steam or electric motive power. It is probable that two bow torpedo tubes will be called for, though the detail of this feature has not yet been decided upon. The Bureau expects that many new schemes will be presented.

THE DUGGAN SWITCH.

So many devices and modifications in railway switches have been patented and introduced, that it began to seem as though nothing new could be devised. From the old pivoted "tongue," moving in a channel rail, to the stub switch was one step, and from the stub switch to the split switch was another and more important step; and the split switch has now been brought to a high degree of perfection.

The Duggan switch, which we illustrate this week, is, however, something decidedly novel in switches, and appears to possess many practical advantages. Its special feature is that the switch rails proper move vertically instead of horizontally. Fig. 1 represents the arrangement of track rails and guard rails, with the switch rails left out, by which it will be seen that a train could trail through the switch from main or branch track without derailment. Fig. 2 shows one set of switch rails in place, so that a train running on it as a facing switch would be turned onto the branch or side track. If the switch rails shown were removed to the other side of the track, as indicated by the dotted lines, the train would take the main track. There are two sets of switch rails, those on one side being raised when those on the opposite side are lowered. There is no strain on the switch rod or on the switch rails, the latter being slightly below the level of the head of the track rails. Fig. 3 shows the switch in detail, but in the original form, with separate outer rails, having the ends overlapping and bolted together. This has been simplified, as shown in Figs. 1, 2 and 4, by cranking or bending the outer rails, to form a continuous rail and save a bolted joint at each end of the switch. The switch rails are of cast steel, hinged at the outer ends, and having a knuckle joint at the inner ends. They are operated by means of a switch rod with two cranks, one set of switch rails being thrown up while the other pair is thrown down to leave a clear flangeway.



FIGS. 1 AND 2. SHOWING ARRANGEMENT OF DUGGAN SWITCH.

The switch can be operated in connection with interlocking apparatus or from an ordinary switch-stand. An objection which appears to present itself is the blocking of the switch by snow, but in the Windsor St. yard of the Canadian Pacific Ry., at Montreal, it has been found that the Duggan switch in use there is the last to require cleaning, and the yardmaster reported that he could keep the yard clear very much easier if it was fitted with Duggan switches throughout. The advantages claimed are as follows: 1, Continuous track for both main and side tracks; 2, no open joints on main or side tracks; 3, fixed supporting rails and guard rails; 4, no facing points, either fixed or movable, for main or side tracks; 5, no automatic stand required; 6, no strain on switch stand or switch rod; 7, no tie-bars required; 8, no trouble from creeping or expansion of rails; 9, no danger of switch moving under passing train; 10, no danger from loose wheels, bent axles or sharp flanges; 11, the switch is very durable and particularly well adapted for any interlocking system.

The switch has been patented in this country and in Europe, and the Massachusetts Railroad Commission has officially approved its use in that state, such action being required by law before railways there are permitted to place it in general use. It is also used by the Canadian Pacific Ry. at many of its important junctions and at the Windsor St. terminus at Montreal. Several are in use on the New York Central & Hudson River R. R. in its New York and Mott Haven yards, and an order is now being filled for 15 more for that road to be placed in the main line at Syracuse, N. Y., where extensive track improvements are to be made. Other roads, including the Old Colony and the Boston & Maine, have given orders for switches, and one is in service in an important place on the tracks at the World's Columbian Exposition.

The patents are owned by the Burnham & Duggan Railway Appliance Co., of Boston, Mass., and the switch is manufactured by the Pennsylvania Steel Co., of Steelton, Pa., which latter company, and also the New York Central & Hudson River R. R. will include the switch in their exhibits at the World's Columbian Exposition.

THE CABLE RAILWAY AT HONG KONG.

The Peak cable railway which affords communication between the city of Hong Kong and the heights above the city has now been in operation about five years. It is 1,207 ft. long, with grades of 4% to 50%, and two curves of 500 ft. and 300 ft. radius. The track is 5 ft. gage, with a double track crossing place 130 ft. long, and a third rail is laid above the crossing, the arrangements being similar to that of the Lookout Mountain cable railway, illustrated and described in our issue of Jan. 7, 1888. The track is laid with 35-lb. steel rails, bolted to cross-ties bedded in concrete. There are eleven iron bridges.

There are two cars, each carried on two four-wheel trucks, with seating capacity for 40 passengers and weighing four tons. A car is attached to each end of a 1⅛-in. wire cable, which makes three turns around two 8-ft. grooved driving drums. There are two compound engines with cylinders, 12×24 ins. and 20×24 ins., and two locomotive type boilers of 40 HP., carrying 120 lbs. pressure, and burning Tonquin coal, which is smokeless. Only one engine and boiler are used at a time. The cable is supported by idler pulleys along the track, at intervals of 9 ft. to 24 ft. on tangents, with vertical and horizontal guide pulleys on the curves. Between the track rail is a 66-lb. grip, or brake, rail.

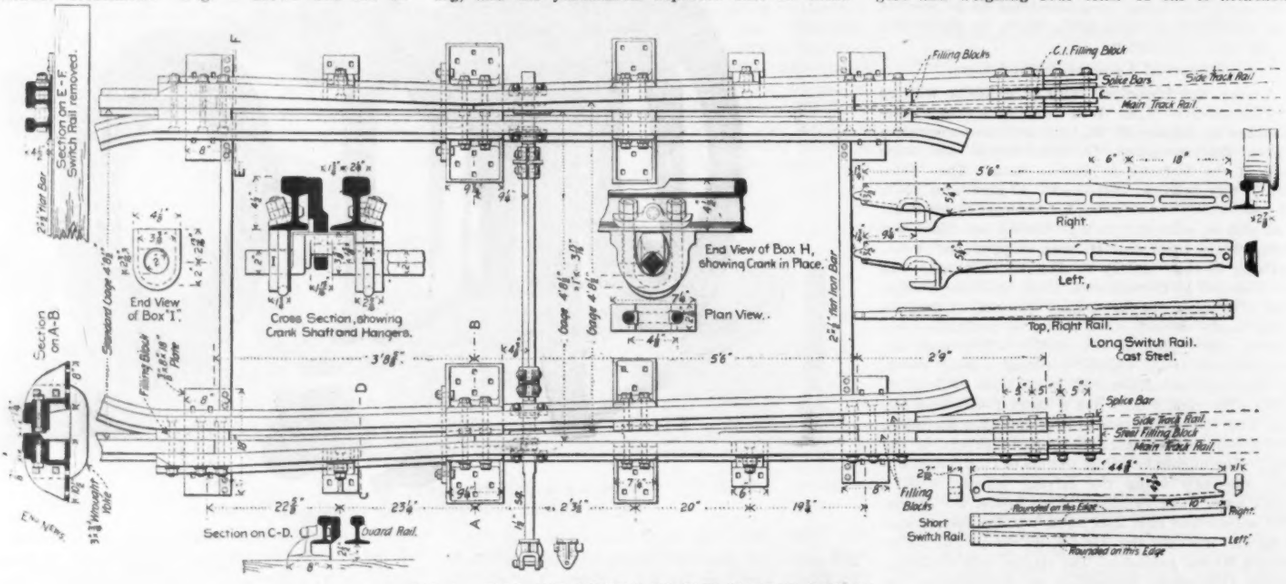


FIG. 3. PLAN AND DETAILS OF THE DUGGAN SWITCH.

for the track brakes. The speed is 6 to 6½ miles per hour, the law limiting it to 9 miles, but at the passing place the speed is reduced to 4 miles per hour, the engineman at the power station having a working diagram which shows him the position of the cars during the trip. There are three intermediate stations, and the trip occupies about 9 minutes. Electric communication between the car conductors and the engineman at the power station is maintained by a lever and arm on the roof of the car, making sliding contact with wires on poles alongside the track. The cost of construction and equipment was about $125,000. Mr. W. K. Wylie is the Resident Engineer and Superintendent.

THE BHATGUR DAM, INDIA.

An interesting masonry and concrete dam is described and illustrated in a report on "Irrigation in India," by H. M. Wilson, M. Am. Soc. C. E. (See Eng. News, March 30, 1893, for review of this report.)

The Bhatgur dam was built to store water for irrigation. It is located in the Presidency of Bombay, India, about 40 miles south of Poona, on the Yelwand River just above its junction with the Nira, as shown on the accompanying plan, Fig. 1. The dam was built under the direction of Mr. J. E. Whiting, C. E.

FIG. 4. DUGGAN SWITCH SET FOR STRAIGHT TRACK.

The drainage area above the dam is 128 square miles. The dam backs up the water for a distance of 15 miles and forms a reservoir having a capacity of 126,500 acre-feet, or 5,510,340,000 cu. ft.

The dam, as shown by the accompanying section, Fig. 2, is of uncoursed rubble masonry in hydraulic cement, with a facing of dressed rubble in courses, the separate stones for the facing not exceeding 9 ins. in depth, to avoid trouble in handling without or with but little machinery.

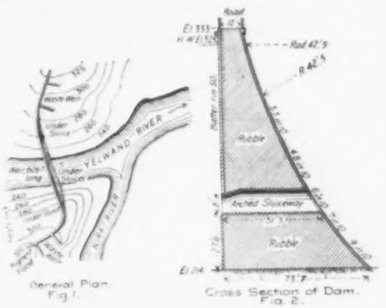
The dam is 4,067 ft. long and 127 ft. high above the foundation, and the crest is 8 ft. above high water. The bottom is 73 ft. 7 ins., and the top 12 ft. wide. The top is intended for use as a roadway.

Further description of the structure is given in the report as follows:*

> The dam is designed on a modern cross-section, by a formula very similar to M. Bouvier's. When full, the pressure on the toe is 5.8 tons per sq. ft., or 90.8 lbs. per sq. in., and when empty is 6.7 per sq. ft. on the heel of the dam. The water supply is such that this reservoir can be filled eight times in the year. Accordingly, it is evident that there is an immense volume of water to be wasted. The alinement of the dam curves in an irregular manner across the valley, so as to follow the outcrop of rock on which it is founded. These foundations are excavated to a depth of 2 ft. in the solid rock, which has required an excavation sometimes as deep as 30 ft. in order to reach homogeneous material. The greatest flood over the dam may be 50,000 sec.-ft., and this is passed off by two wasteways, and 20 (17)* under-sluices. The wasteways are constructed at either end of the dam in the body of the dam itself, and are arched over so that the roadway is continuous above them. Their total length is 810 ft., and the flood may pass 8 ft. in depth through them. The northern wasteway, that on the left bank, consists of 45 arches of 10-ft. span each, which can be closed by automatic falling gates. The wasteway at the south end consists of 36 arches, with the same dimensions and construction as the others. Jutting out from the main dam on the downstream side, in such manner as to inclose these wasteways, are constructed walls of masonry which guide the discharged flood-water into separate channels, which carry it into the rivers below the main dam.
>
> Of the under-sluices 15 are constructed in the center of the dam at its deepest point and are placed 17 ft. apart, each being 4×8 ft. in dimensions, with their sills 60 ft. below the high-water line. With this enormous head these under-sluices will discharge 20,000 sec.-ft., which is an average maximum flood, and they have successfully withstood several years of flood without injury to the joints of the ashlar masonry with which they are lined. Under full head the velocity through these sluices is 36 ft. per second. Above this row of 15 under-sluices, and near the surface slope of the valley, are two others of the same dimensions, one 2 (20)* ft. above the main row and the other 50 ft. above the main row. These sluices are constructed, as are the main sluices, with a lining of the best ashlar masonry, with pointed joints. They are closed by iron gates, which slide vertically. These gates weigh two tons each, and are operated by steel screws, worked from above by a female capstan-screw operated by hand levers. The gates are protected from injury by floating objects by means of stout gratings of wood on the upstream entrance. There is 30 ft. of idle space below the under-sluices, and this is expected to fill up with silt.
> on the upstream entrance. There is 30 ft. of idle space below the under-sluices, and this is expected to fill up with silt.
>
> The object of these sluices is, primarily, to discharge the water of the reservoir, which then flows for nearly 20 miles down the Nira River to the diversion or pickup weir, at Vir, which turns it into the head of the Nira Canal. Fewer sluices would have accomplished this end, but additional ones were constructed with the object of keeping the reservoir above them free from sediment. This can be accomplished only by leaving the sluices open when much sediment is carried in suspension, and it is very doubtful if they would clean the reservoir of silt if it were once permitted to fill up.
>
> (In addition to the 17 under-sluices there are five openings, each 3 ft. in diameter, with their bottoms 60 ft. below the high-water line. These openings are for the supply of turbines.)*

Mr. A. Hill, Superintending Engineer, says of the scouring effect of these sluices:

> Scouring sluices have little effect unless the area of the openings is great compared to the area of the floods. To remove silt already deposited they are useless, as has been proven by the manner in which they have silted up at Lake Fife and at Vir and other places where their area is small compared with that of the area of the floods. At Bhatgur they are intended not to remove silt deposited already, but to prevent its deposit by carrying it off while in suspension. If the dam is high and the discharge of the under-sluices will keep the flood level below the full supply level, then they will be efficient. If the dam is low and the sluices will not keep the flood level below full supply, they will have little effect.



Plan and Cross-Section of Bhatgur Dam, India.

Experience on the Betwa reservoir and elsewhere bears out these conclusions, with the addition that their scouring or preventive effect is felt a very few feet to either side of the sluices, and silt will deposit close to their entrance. In other words, they do little more than keep an open channel above them.

The automatic sluice gates which are to be used on the wasteway of this dam are peculiar, and are well worth describing. They are patented by Mr. E. K. Reinold, their inventor, and their object is, that when the flood reaches its maximum height, 8 ft. below the crest of the dam, the gate shall be entirely open, and as the flood subsides the gate shall automatically rise until it is entirely closed, thus adding to the reservoir capacity by the depth of the waste weir. The gates are 8×10 ft., and they thus increase the depth of this reservoir by 8 ft. Where water is valuable such an expedient may be of the greatest financial importance. As yet, none of these gates have been in actual operation on any great work, but the writer saw a large model in successful operation, and it was considered so satisfactory by the government that they were willing to introduce it on this work.

The gate has two contact surfaces, one on the standard face, against which it presses, and one on the face of the gate. These surfaces slide parallel to each other and are the surfaces of inclined planes. The gate rests on wheels running on rails, and the axes of these wheels are parallel to the line of rails and at a slight angle to the contact planes, so that the latter do not touch until the gate is fully raised or closed, thus permitting by leakage a large amount of the flood water to run out of them until the last moment. The accompanying illustration, Fig. 3, explains the operation of the gate. It is automatically operated by means of counterpoises balanced in water cisterns, the weight

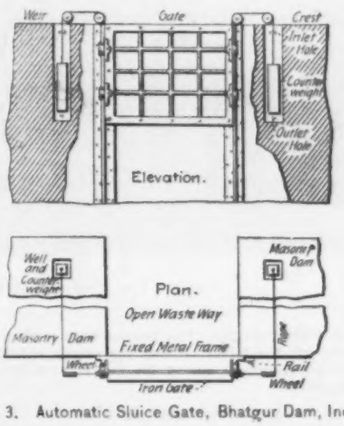


Fig. 3. Automatic Sluice Gate, Bhatgur Dam, India.

of which exceeds the weight of the gate by a little more than the amount of the friction, and they act by displacing their volume of water in the cisterns in

* A few corrections have been made to this quotation from notes sent us by Mr. Wilson since the report was published. The section of the dam given in the report and also in Mr. Wilson's "Manual of Irrigation Engineering" (see Eng. News, March 30, 1893, for review), show the upper two-thirds of the structure to be of concrete, as originally designed, although the text in each book states that it is built of rubble masonry throughout. The corrections and additions are indicated by parentheses.

* See previous note.

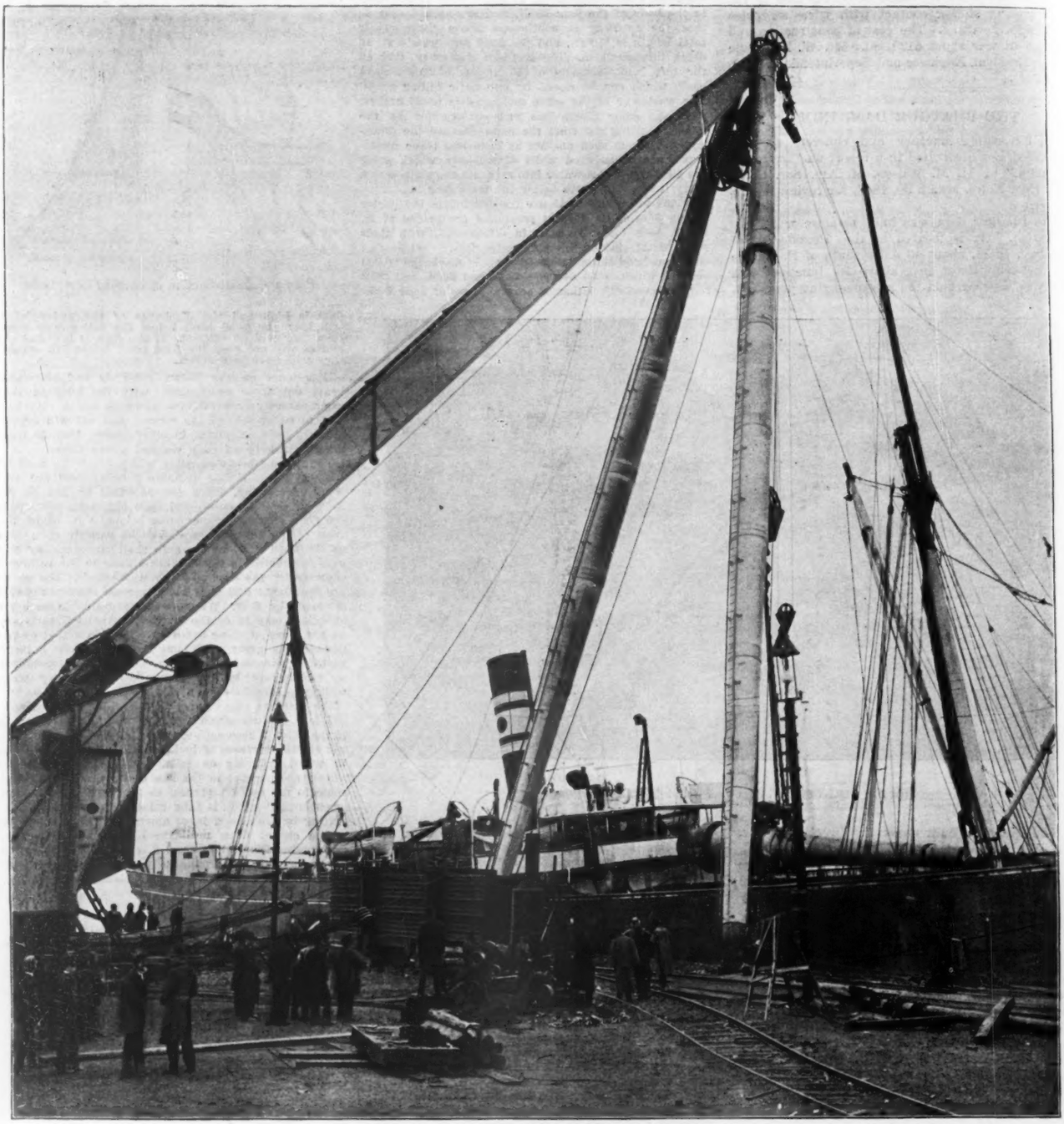
* See previous note.

which they plunge, thus lessening their weight by that of this volume of water. As the water flows over the top it flows simultaneously into the cast-iron boxes in which the counter-weights hang through inlets placed on a level with the gate top. This water entering the cisterns reduces the weight of the counterpoises, and the gate, then being the heavier, sinks, opening the wasteway. When the water ceases to enter the boxes, owing to its having fallen below the level of the inlets, it soon runs out from holes at the bottom, and the counter-weights then become heavier than the gate and lift the latter. Giving the proper weight to these counterpoises is one of the important details of the apparatus.

THE 130-TON SHEARS AT SPARROW'S POINT.

We illustrate in the accompanying engraving the 130-ton shears erected at Sparrow's Point, Md., by the Maryland Steel Co., which have recently attracted so much attention from the fact that their first use was for lifting the 122-ton Krupp gun from the steamship "Longueil" and placing it on the car especially designed for its transportation to Chicago, which we illustrated and described in detail in our last issue. In addition to the 122-ton gun the shears were also used to unload the large armor plates of 40 and 60 tons weight, a number of smaller guns, the boiler plates, shafting, and several smaller articles of iron and steel which will form the principal part of the exhibit of the Krupp works, at Essen, Germany, at the World's Columbian Exposition. As stated before the shears were constructed and erected by the Maryland Steel Co., and they will be used principally to place the boilers and heavy machinery in the vessels constructed at the company's ship yards.

The general construction of the shears is quite clearly shown in the illustration. The two front legs are hollow steel tubes 116 ft. long and 4 ft. in diameter at the middle, tapering to 3 ft. in diameter at the ends. They are 45 ft. apart at the bottom and meet at the top, where they also meet the top of the back leg. Each leg is composed of steel plates ½ in. in thickness and is thoroughly braced inside. The bottom of each leg is a spherical steel casting which rests in a cast steel cup firmly fastened to a concrete foundation on piles, forming practically a ball and socket joint. The back leg consists of two parallel plate girders finely braced together. At the top this leg is connected with the two front legs by a pivot pin and at the bottom it is provided with rollers which run on the curved



THE 130-TON SHEARS AT SPARROW'S POINT, MD.; MARYLAND STEEL CO., BUILDERS.

The 17-in. barbette armor-plate of the "Oregon" is to be Harveyized, under an agreement just concluded between the Secretary of the Navy and the Carnegie Steel Co. The contract covers the application of the Harvey process to about 1,400 tons of plate.

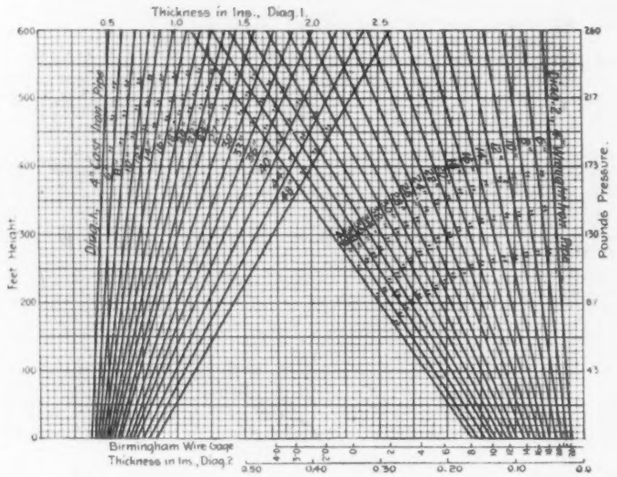


PLATE 1. THICKNESS OF CAST AND WROUGHT IRON PIPES.

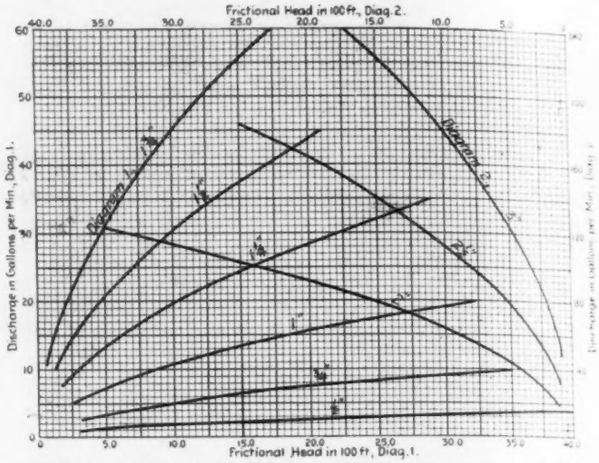


PLATE 2. FRICTIONAL HEAD IN SERVICE PIPE PER 100 FT. OF LENGTH.

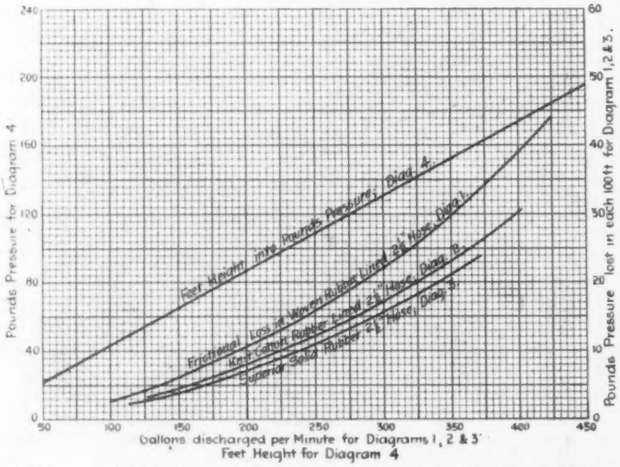

Pounds Pressure for Diagram 4
Pounds Pressure lost in each 100 ft for Diagram 1, 2 & 3.
Gallons discharged per Minute for Diagrams 1, 2 & 3
Feet Height for Diagram 4

PLATE 5. FRICTIONAL LOSS IN HOSE, AND FEET HEIGHT REDUCED TO POUNDS PRESSURE.

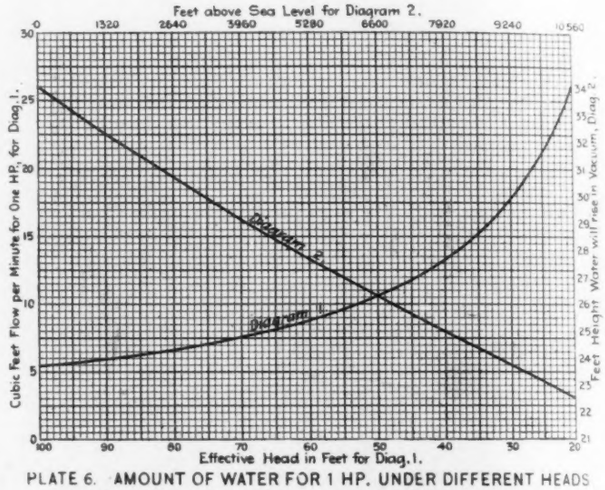

Feet above Sea Level for Diagram 2.
Cubic Feet Flow per Minute for One HP. for Diag. 1.
Feet Height Water will rise in Vacuum, Diag. 2.
Effective Head in Feet for Diag. 1.

PLATE 6. AMOUNT OF WATER FOR 1 HP. UNDER DIFFERENT HEADS HEIGHT OF WATER IN VACUUM AT DIFFERENT ELEVATIONS

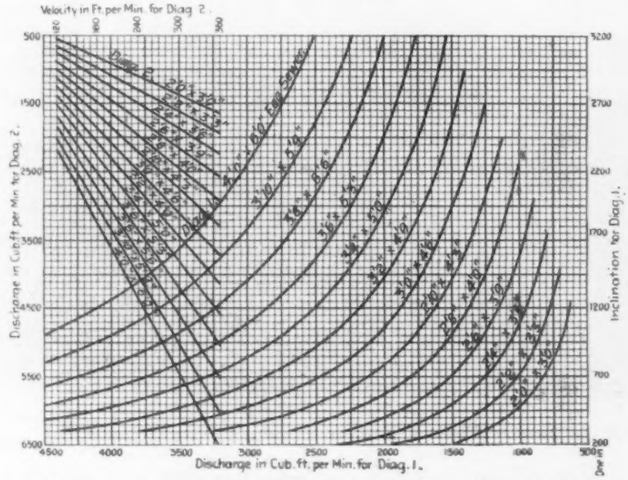

Velocity in Ft. per Min. for Diag. 2.
Discharge in Cub. ft. per Min. for Diag. 2.
Inclination for Diag. 1.
Discharge in Cub. ft. per Min. for Diag. 1.

PLATE 9. DISCHARGE AND VELOCITY IN EG -SHAPED SEWERS FLOWING FULL.

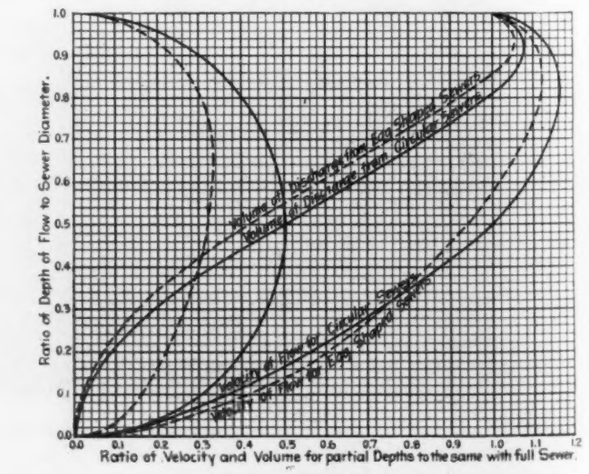


PLATE 10. RATIOS OF VELOCITY AND VOLUME WITH SEWER PARTIALLY FULL TO THE SAME WHEN FULL.

DIAGRAMS FOR HYDRAULIC FORMULAS; A. L. Adams,

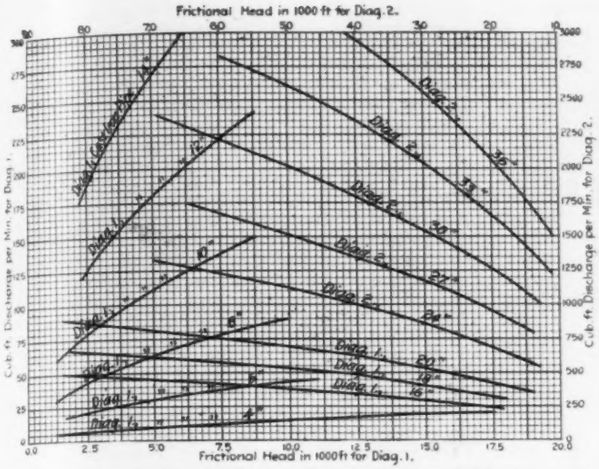

Frictional Head in 1000 ft for Diag. 2.
Cub. ft. Discharge per Min. for Diag. 1.
Cub. ft. Discharge per Min. for Diag. 2.
Frictional Head in 1000 ft for Diag. 1.

PLATE 3. FRICTIONAL HEAD IN CLEAN CAST IRON PIPE PER 1,000 FT. OF LENGTH.

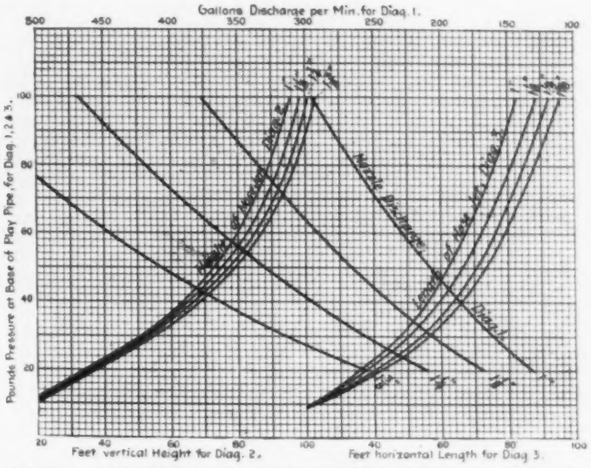

Gallons Discharge per Min. for Diag. 1.
Pounds Pressure at Base of Play Pipe for Diag. 1, 2 & 3.
Feet vertical Height for Diag. 2.
Feet horizontal Length for Diag. 3.

PLATE 4. FIRE STREAMS THROUGH SMOOTH NOZZLES: FREEMAN'S EXPERIMENTS.

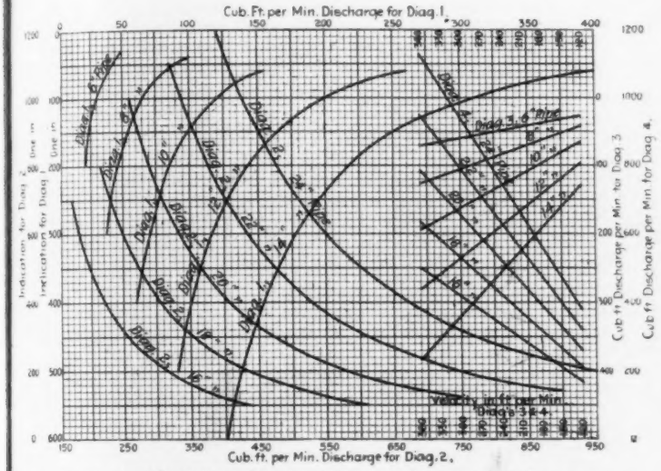

Cub. Ft. per Min. Discharge for Diag. 1.
Cub. ft. per Min. Discharge for Diag. 2.
Cub. ft. Discharge per Min. for Diag. 3.
Cub. ft. Discharge per Min. for Diag. 4.

PLATE 7. DISCHARGE AND VELOCITY OF FLOW IN 6 TO 24 IN. PIPE SEWERS.

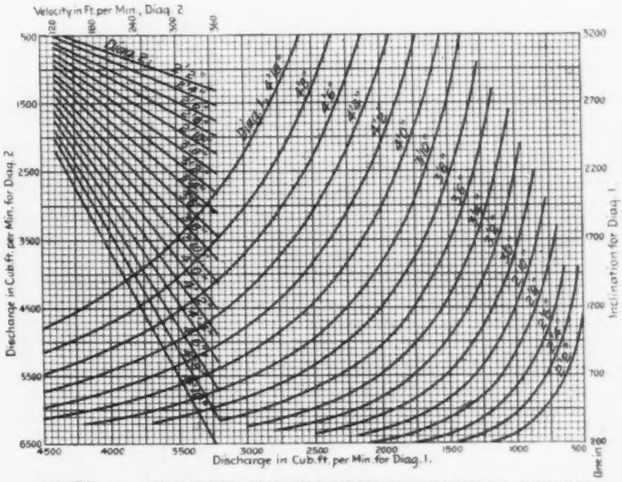

Velocity in Ft. per Min., Diag. 2
Discharge in Cub. ft. per Min. for Diag. 2
Discharge in Cub. ft. per Min. for Diag. 1.
Inclination for Diag. 1.

PLATE 8. DISCHARGE AND VELOCITY IN CIRCULAR SEWERS FLOWING FULL.

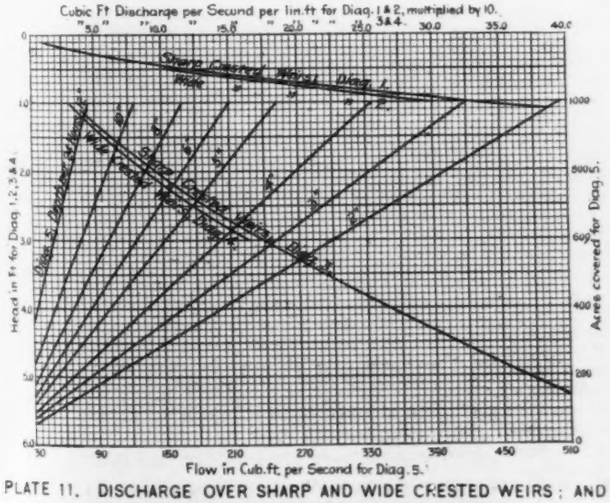

Cubic Ft Discharge per Second per lin. ft for Diag. 1 & 2, multiplied by 10.
Head in Ft for Diag. 1, 2, 3 & 4.
Area covered for Diag. 5.
Flow in Cub. ft. per Second for Diag. 5.

PLATE 11. DISCHARGE OVER SHARP AND WIDE CRESTED WEIRS; AND CU. FT. PER SEC. CONVERTED INTO ACRE DEPTHS.

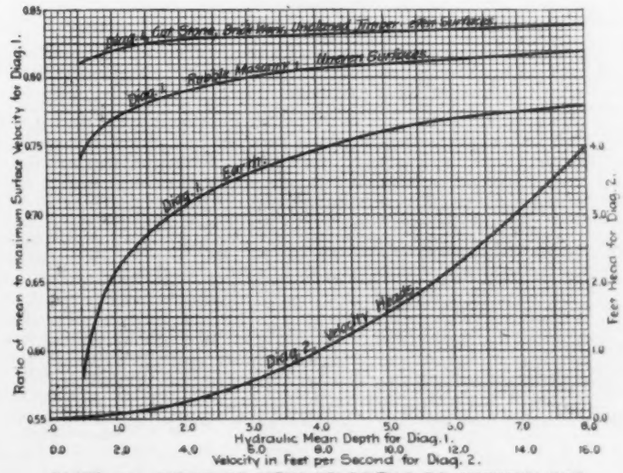

Ratio of mean to maximum Surface Velocity for Diag. 1.
Feet Head for Diag. 2.
Hydraulic Mean Depth for Diag. 1.
Velocity in Feet per Second for Diag. 2.

PLATE 12. RATIOS OF MEAN VELOCITIES TO MAXIMUM SURFACE VELOCITIES.

track shown at the left of the illustration. This back leg is 126 ft. long, and is connected by a suitable mechanism with the hydraulic machinery for operating the shears.

The operation of the shears is quite simple, consisting merely in moving the back leg forward along the curved track until the top overhangs the vessel's hold, and then in drawing it back until the top overhangs the railway track just at the rear of the two front legs. Starting at the outer limit of the curved track the leg is brought in as far as the middle point of the track by means of steel ropes passing around sheaves at the lower end of the leg and operated by hydraulic power. After reaching the middle point of the track where the front legs pass beyond the vertical toward the rear, there is of course, a tendency of the shears to fall in that direction, and this is prevented by two hydraulic rams which meet the bottom of the rear leg at this point and allow it to gradually descend along the curved track. To move the shears back to their original position the operations are, of course, the reverse of those already described.

The shears are provided with two separate and independent hoisting devices. For light weights of 15 tons or less there is an ordinary snatch block operated by a 1-in. steel rope, which passes over sheaves at the top of the shears and down to the drums in the power-house. This drum is operated by a hydraulic ram having a diameter of 18½ ins. and a stroke of 14 ft. The main block is operated by four hydraulic rams, 18½ ins. in diameter and having a stroke of 16 ft. 3 ins, placed in pairs on each side of the bottom of the back leg. From each pair of rams two steel ropes pass to the top of the shears, then down to the main block and then over sheaves placed centrally at the top of the shears.

It is not certainly known what the total capacity of these shears is. Thus far the heaviest weight raised was the test load of rails shown in the engraving, which with the necessary tackling was estimated to be about 140 tons. In lifting the 122-ton gun the indicated pressure was 1,640 lbs. per sq. in. No difficulty was found in handling either of these loads. The illustration shows the 122-ton gun just as it was being lifted clear of the deck of the "Longueil."

DIAGRAMS FOR HYDRAULIC FORMULAS.

(With inset.)

By A. L. Adams, C. E., and R. G. Gemmell, Assoc. M. Am. Soc. C. E.

The twelve diagrams on the accompanying inset afford in convenient form a ready means of solving a large proportion of the formulas which hydraulic engineers have occasion to use in ordinary practice. The explanation of the diagrams and directions for their use are as follows:

Plate 1: Requisite thickness of cast and wrought iron pipe.—Diag. 1. Fanning's formula for cast iron pipe, $t = \frac{(p + 100)\,d}{.4\,s} + .333\left(1 - \frac{d}{100}\right)$, with factor of safety of ten and ultimate strength taken at 18,000 lbs., per sq. in. of section of metal. Take feet head or pounds pressure on vertical scale and find thickness of shell in inches on the top horizontal scale.

Diag. 2. Fanning's formula for wrought iron pipe, $t = \frac{(p + 100)\,d}{.5\,s}$, with factor of safety of four and ultimate strength taken at 50,000 lbs. per sq. in. Take feet, head or pounds pressure on vertical scales and find thickness of shell in inches or Birmingham wire gage on the bottom horizontal scale. For straight double riveted pipe add 20% to the thickness thus obtained, and for single straight riveted pipe add 30%.

Plate 2: Frictional head in service pipe per 100 ft. of length.—Diag. 1. Fanning's formula for frictional head in clean service pipe from ½ to 1¼ ins. in diameter, $h'' = v^2\,(4\,m)\,\frac{1}{2\,g\,d}$. Take flow in gallons per minute on left hand vertical scale and find frictional head in feet for each 100 ft. in length of pipe on bottom horizontal scale.

Diag. 2. Same formula as in Diag. 1 for 2 to 3-in. service pipes. Take flow in gallons per minute on right hand vertical scale and find frictional head in feet for each 100 ft. in length of pipe on top horizontal scale.

Plate 3: Frictional head in clean cast iron pipe per 1,000 ft.—Diag. 1. Fanning's formula for frictional head in feet for flow in clean cast iron pipes from 4 to 14 ins. in diameter, $h'' = v^2\,(4\,m)\,\frac{1}{2\,g\,d}$. Take flow in cubic feet per minute on left hand vertical scale and find frictional head in feet for each 1,000 ft. in length of pipe on the bottom horizontal scale.

Diag. 2. Same formula as in Diag. 1, 16 to 36-in. cast iron pipe. Take flow in cubic feet per minute on right hand vertical scale and find frictional head in feet for each 1,000 ft. in length of pipe on the top horizontal scale.

Plate 4: Fire streams through smooth nozzles; Freeman's experiments.—Diag. 1. Take pounds pressure at base of play pipe on left hand vertical scale and find gallons discharged per minute from nozzles of sizes indicated on the upper horizontal scale. To find discharge from ring nozzles under similar conditions, deduct 24% from the discharge given by diagram.

Diag. 2. Take pounds pressure at base of play pipe on left hand vertical scale and find maximum height as a first-class fire stream on corresponding lower horizontal scale. For maximum height as a fair fire stream, add 10% to results obtained from diagram.

Diag. 3. Take pounds pressure at base of play pipe on left hand vertical scale and find maximum horizontal length of jet as a first-class fire stream on corresponding lower horizontal scale. For maximum length as a fair fire stream add 12% to results obtained from diagram.

Plate 5: Frictional loss in hose; and feet height reduced to pounds pressure.—Diags. 1, 2 and 3. Take gallons discharged per minute on lower horizontal scale and find loss in pounds pressure per 100 ft. of 2½-in. hose of the different classes indicated, as given by Freeman's experiments, on left hand vertical scale.

Diag. 4. Take feet, height on lower horizontal scale and find corresponding pounds pressure on left hand vertical scale.

Plate 6: Amount of water necessary to constitute 1 HP. under different heads; and height water will rise in vacuum at different elevations above sea level.—Diag. 1. Take effective head in feet on lower horizontal scale and find required flow in cubic feet per minute necessary to constitute a full theoretical horse power on left hand vertical scale.

Diag. 2. Take height above sea level on upper horizontal scale and find height water will rise in vacuum on left hand vertical scale.

Plate 7: Discharge and velocity of flow in 6 to 24-in. pipe sewers.—Diag. 1. Computed by Kutter's formula, with "N" = .013; with "N" = .012; add 10%. Take inclination on left hand vertical scale and find discharge in cubic feet per minute on the top horizontal scale.

Diag. 2. Same formula as Diag. 1. Take inclination on left hand vertical scale and find discharge in cubic feet per minute on the bottom horizontal scale.

Diags. 3 and 4. Take discharge in cubic feet per minute on left hand vertical scale and find velocity in feet per minute on horizontal scales.

Plate 8: Discharge and velocity in circular sewers flowing full.—Diag. 1. Computed by Kutter's formula with "N" = .013; with "N" = .015, deduct 18%. Take inclination on the right hand vertical scale and find discharge in cubic feet per minute on the bottom horizontal scale.

Diag. 2. Take discharge in cubic feet per minute on left hand vertical scale and find velocity in feet per minute on top horizontal scale.

Plate 9: Discharge and velocity in egg-shaped sewers flowing full.—Diag. 1. Computed by Kutter's formula with "N" = .013; with "N" = .015; deduct 18%. Take inclination on the right hand vertical scale and find discharge in cubic feet per minute on the bottom horizontal scale.

Diag. 2. Take discharge in cubic feet per minute on left hand vertical scale and find velocity in feet per minute on top horizontal scale.

Plate 10: Ratios of velocity and volume with sewer partially full, to the same when full.—This diagram is computed by Kutter's later formula, which allows for the decrease of the frictional coefficient, as the mean radius increases. The height of the sewer and the volume of discharge and velocity of flow with sewer running full are all taken as unity. Find on vertical scale the ratio of the depth of flow to the sewer diameter and on the horizontal scale the ratio of the velocity and volume at that depth to same when sewer is flowing full depth.

Plate 11: Discharge over sharp and wide crested weirs and cubic feet per second converted into acre depths.—Diags. 1 and 3. Computed by the formula $Q = 5.35\,m\,l\,H^{3/2}$, with variable value of m. Take head in feet on weir from left hand vertical scale and find cubic feet discharge per second per lineal foot on weir on top horizontal scale. Deduct 1-10 the head upon weir from its length for each end contraction.

Diags. 2 and 4. Computed by the formula $Q = 3.012\,l\,H^{1.53}$, suggested by Mr. Francis. Use diagrams same as described for 1 and 3.

Diag. 5. Cubic feet per second converted into acre depths, or depths of rainfall per 24 hours converted into second feet. Find acres covered or drained on left hand vertical scale and cubic feet per second on bottom horizontal scale.

Plate 12: Ratios of mean velocities to maximum surface velocities.—Diag. 1. Computed by Bazin's formula. Take hydraulic mean depth on bottom horizontal scale and find ratio of mean velocity to maximum surface velocity on left hand vertical scale.

Diag. 2. Head required to generate different velocities. Take velocity in feet per second to be generated from bottom horizontal scale and find the velocity head required on the right hand vertical scale.

(These twelve diagrams of hydraulic formulas include several which have already been published in this journal, although in a different form. But with one exception diagrams designed to aid in the solution of so many problems have not been presented on a single sheet in this journal before and in the one instance when this was done (Eng. News, Sept. 6, 1890) there were so many separate diagrams on one plate as to render the whole somewhat confusing.*—Ed.)

The American Society of Civil Engineers has appointed Messrs. Edward P. North, L. L. Buck and Foster Crowell as a committee of information and courtesy for the benefit of visiting engineers during the World's Columbian Exposition. As it is the purpose of this committee to aid these engineers in gaining convenient access to works and objects of engineering interest in the country, members of the society and others are requested to give in detail to the committee any information regarding works in their charge or in their vicinity, and also to state in what foreign language either they or those about them can communicate with visitors.

The American Street Railway Association has secured the Milwaukee Industrial Exposition Building for the exhibition of supplies and manufactures of every nature used in the street railway business, in connection with the twelfth annual meeting of the association, which will be held in Milwaukee, Wis., commencing Oct. 18, and lasting three days. The dimensions of the building are as follows: Length, 400 ft.; greatest width, 293 ft.; height, 80 ft.; height of dome, 138 ft.; height of landing above dome, 145 ft.; to top of cupola roof, 202 ft.; area of ground floor, 87,000 sq. ft. Power will be supplied from line shafting. The meetings will be held in the main hall of the same building. Particulars may be obtained from the secretary, Wm. J. Richardson, Brooklyn, N. Y.

The Abt rack railway from Aix-les-Bains to Rivard, in France, is described at some length in the March 18 issue of "Le Genie Civil." This line runs from Aix-les-Bains to the mountain health resort of Rivard, with three intermediate stations. It is a single track line of 1-m. gage, and is 9,350.9 m. (9.58 miles) long, measured along the grade, and has a rise of 1,226 m. (4,221 ft.). The grades run from 1% to 21%, the lowest grades being at the stations, where there are also side

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* For the convenience of any wishing to look up the diagrams already published, the following references are given:

"Discharge of Water from Jets and in Long Mains." By G. B. Pearsons. Eng. News, Sept. 23, 1876.

"The Practical Calculation of the Heads, Diameters and Discharges of Long Pipes." By E. Sherman Gould, M. Am. Soc. C. E. Eng. News, Feb. 16, 23, March 9, 16 and 23, 1889. An extended discussion, with illustrations.

"Diagrams of Various Hydraulic Formulas for Approximate Use." Compiled by J. Leland Fitzgerald, M. Am. Soc. C. E. Eng. News, Sept. 6, and (correction) 13, 1890.

"Bazin's Experiments with Weirs." Eng. News, Dec. 27, 1890.

"Discharging Capacity of Water Mains." By Jas. Duane. Eng. News, Jan. 2, 1892.

"Flume and Ditch Diagram." By A. L. Adams (of Adams & Gemmell, contributors of the above diagrams) Feb. 13, 1892.

"Head Lost in Smooth Pipes per 1,000 ft. in Length," in article by J. T. Fanning, M. Am. Soc. C. E., on "Distribution Mains and Fire Service." Eng. News, July 14, 1892.

"Diagrams for Flow in Pipe Sewers." By Prof. A. N. Talbot. Eng. News, Aug. 11, 1892.

tracks for passing trains, and the average grade is 14%. There are several bridges and two tunnels on the line, and, in addition, a large amount of masonry work, principally retaining walls. The most important bridge is a masonry arch structure 107 m. (351 ft.) long, built on a curve of 14½%, and a grade of 17%. This consists of five arches of 12-m. (39.3 ft.) span. The two tunnels are 20 m. (65.6 ft.) and 100 m. (328 ft.) long, respectively. The longer tunnel is built on a curve of 23½%. The stations are of wood, built in the style of Swiss chalets.

A special report on garbage disposal was recently made by Mr. C. W. Adams, City Surveyor, of Utica, N. Y. The report contains information obtained by correspondence regarding garbage disposal in 38 cities, in 28 of which garbage is collected and removed at public cost, 7 of the 28 destroying the garbage by cremation or chemical treatment. Mr. Adams recommends that proposals for the construction and operation of garbage disposal plants be secured from Simonin & Simonin, Philadelphia, and the Engle Sanitary & Cremation Co., New York city.

The plans for the extensive railway terminals and docks to be constructed at Toleston, Ind., by the three great dressed meat interests of Chicago, headed by Armour, Swift and Morris, have been completed by W. S. Jones, Chief Engineer, Chicago Union Transfer Ry. Co. These interests have secured 4,000 acres of the swamp land bordering the southern shore of Lake Michigan, near the village of Toleston, Ind., which will be laid out in residence lots, manufacturing sites, railway terminals and dockage facilities, as well as furnish room for the syndicate's packing houses, now located in Chicago. According to the newspapers, the plans provide for 40 miles of railway tracks, 8 miles of improved river frontage, 5½ miles of frontage on slips, a harbor 1½ miles long and 2,000 ft. wide, 18,000 residence lots, 800 manufacturing lots, 116 × 160 ft., with private street and side track entrances; 300 dock lots, 100 × 150 ft., with railway facilities; stockyards site of Ry., and tracks for the Toleston Belt R. R., which is 600 acres, terminal yards for Elgin, Joliet & Eastern to furnish the terminal for the belt line of the Chicago Union Transfer Ry. There will also be an outer harbor, bounded by a breakwater which will be continued on as a winding street into the residence district. A canal 200 ft. wide will lead into the Grand Calumet River, which will be provided with slips, and the river will also be dredged to a depth of 20 ft. The total cost of the improvements is estimated at $5,000,000. The surveys and plans have been completed, and it is announced that work will be begun about June 1.

PERSONALS.

Mr. G. M. Norris has been elected City Engineer of Madison, Wis.

Mr. C. H. Ladomus has been elected City Engineer of Chester, Pa.

Mr. T. N. Reiter has been elected City Engineer of Ishpeming, Mich.

Mr. J. E. S. Pryor has been appointed City Engineer of Hagerstown, Md.

Mr. William Jackson has been re-elected City Engineer of Boston, Mass.

Mr. J. Trumbor has been elected Town Engineer of Glenwood Springs, Colo.

Mr. H. H. Pendleton has been appointed City Engineer of Independence, Mo.

Mr. D. M. Philbin has been appointed General Manager of the Duluth, Mesaba & Northern R. R.

Mr. George H. Benzenberg, M. Am. Soc. C. E., has been re-appointed City Engineer for a term of three years.

Mr. J. S. Harris has been elected President of the Philadelphia & Reading R. R. Co., vice Mr. McLeod, resigned.

Mr. Harvey Linton, M. Am. Soc. C. E., has been re elected City Engineer of Altoona, Pa., for three years, being his third term.

Col. O. E. McClellin, Superintendent of Middle Division, Pennsylvania R. R. Co., has tendered his resignation, to take effect May 1, and it is rumored that he will accept a responsible government position.

Mr. Charles R. Peddle, Purchasing Agent of the St. Louis, Vandalia & Terre Haute Ry., died at Terre Haute, Ind., April 19. He had been connected with the road since 1851 (then the Terre Haute & Indianapolis R. R.).

Mr. P. C. Brewer, Supervisor of the Trenton "cut-off" of the Pennsylvania R. R., has tendered his resignation, to take effect May 1, and he will accept a position in the switch and signal department of the New York Central & Hudson River R. R.

Mr. A. W. Cooke has been appointed City Engineer of Chicago, Ill. Mr. O. H. Cheney has been appointed Superintendent of Sewers, Mr. John Fitzsimmons Superintendent of Water-Works, and Mr. Hiram J. Jones Commissioner of Public Works.

Mr. Frederick Rosenberg, late Chief Engineer and Assistant General Manager of the Colorado Coal & Iron Co., and formerly connected with the Pennsylvania R. R., has entered the firm of Jutte & Foley, general railroad contractors, of Pittsburg. He will open an office in Philadelphia, and will look after the eastern interests of the firm.

Mr. J. S. Jeans, of London, is reported to have tendered his resignation as Secretary of the Iron and Steel Institute of Great Britain, which office he has held for 16 years. He will still be Secretary of the Iron Trade Association. His successor as Secretary of the Iron and Steel Institute will be Mr. Bennett H. Brough, his present chief assistant.

Mr. T. H. McKenzie, M. Am. Soc. C. E., of Southington, Conn., has been appointed a member of the State Board of Health. He has been largely engaged on sewerage and water-works, and has been connected with nearly every project in the state for sewage disposal, either as the engineer in charge or as consulting engineer of the State Board of Health. The board is now composed of four physicians, one attorney and one engineer.

Mr. H. Bergendahl has resigned as Superintendent of Iron Construction for Henry Ives Cobb, of Chicago, and associated himself with Quinn & Hammond, with the firm name of Bergendahl, Quinn & Hammond, to carry on the practice of an engineering and contracting business in structural work generally, and making a specialty of wrecking and erecting. Mr. James Lorenz, a contractor for wood construction, is associated with them.

NEW PUBLICATIONS.

DES INGENIEURS TASCHENBUCH. Herausgegeben vom akademischen Verein "Huette." Fuenfzehnte voellig umgearbeitete Auflage, mit ueber 1,000 in den Satz eingedruckten Abbildungen und 1 Tafel. Berlin, 1892: Verlag von Wilhelm Ernst & Sohn. Bound; postage paid. $3.01.

This "Engineer's Pocketbook" is edited by the "Hutte," an academic society of Berlin. The fifteenth edition is published in two parts, with 826 pp. in the first part, and 744 pp. in the second. It is full of tables, though these are not numbered. The index is excellent; but it might be noted that, while the pages increase in number in the several editions, the index shrinks, as follows: 13th Edition, 3,950 lines of index; 14th, 3,400 lines; 15th, 2,850 lines. In comparison, "Haswell," with 936 pp. of matter has 3,350 lines of index, and "Trautwine," with the same number of pages, has about 4,600 lines of index. As indicating the scope of the work, it may be mentioned that 23 pp. and 41 cuts are devoted to the subject of cranes, generally; 11 pp. and 14 cuts to hydraulic cranes; 20 pp. and 18 cuts to pumps; and blowers, air-compressors and water-motors are treated with corresponding thoroughness, and no less than 155 pp. and 168 cuts are required for the discussion of steam engines and boilers. In the second part, which is more particularly the civil engineering portion, are treated: Instruments and their adjustment; railway engineering, including construction and operation, with a short article on cable transmission; the mechanics of beams, girders and trusses, using both analytical and graphical methods; retaining walls, buildings, roofs, shipbuilding, iron and steel manufacture, electrical engineering, etc.

What Haswell and Trautwine are to the English-reading engineer, "Huette" is to his German-reading brother. Indeed, in some respects it is more; for, besides dealing very thoroughly with matters connected with both civil and mechanical engineering, it treats also of marine construction, of iron and steel manufacture, of electricity, of mills, of textile industries and of gas-making. Comparing the present, or 15th (1892) edition with the 14th (1890), and the 13th (1887), we are struck, first, with the great increase in bulk: the three editions containing, respectively, 1,144, 1,374 and 1,544 pages. When we consider that Haswell and Trautwine together contain only about 1,800 pages, it will be seen that these German dimensions put to shame those American engineers who have begun to groan under the modestly-increasing bulk of our own engineers' pocketbooks. (The preface to the 14th edition of "Huette" adds an interrogation point in applying to itself the title of "pocketbook.")

But not only are the late editions noteworthy on account of their gigantic dimensions, they have fairly earned the right to style themselves, as they do upon their title-pages, "voellig umgearbeitet" (thoroughly re-worked). From beginning to end the volume bears abundant witness to plenty of hard and conscientious labor on the part of the extensive corps of experts of high standing who act as collaborators in this work. The general plan of the book remains the same as in earlier editions, but most of the subjects treated are more fully elaborated than before, while in the matter of illustrations, the new edition eclipses even the excellent performance of its predecessors. As this is a German work, and intended for use by German engineers, it goes without saying that it is intensely "mathematical,"—more so, indeed, than the average American or English engineer would find necessary, or even convenient, but the extreme thoroughness and the careful attention to systematic arrangement and clearness of presentation manifest on every page go far to mitigate the severity of this treatment.

The last two editions, as previously mentioned, are divided each into two Abteilungen, or parts (the first chiefly theoretical), and in the present one each part has its separate table of contents, while in the last preceding one the tables of contents of both parts are (more fitly, we think) prefaced to the first part. A still more curious and inexplicable innovation in present issue is that the preface is placed at the beginning of the second part. Fortunately (and somewhat contrary to German practice), a fairly good index of sixteen pages, referring to both parts, appears at the end of the volume. The division into two parts (I. and II.), of course, necessitates here the use of the symbol I. or II. in each entry. This division, as explained in the preface to the 13th edition, was made partly because of the increased size of the work and partly to facilitate the press-work—the preceding edition having been exhausted before the new one could be got to press. If, however, the two parts are to be carried separately it would appear highly desirable that each should have its separate index. The work has from the first been one that no German-reading engineer could afford to dispense with, and the character of the present edition renders this necessity even more imperative than ever.

The technical portions of the work are based, of course, upon European practice, and are therefore necessarily of less immediate and practical value to American engineers than they would be if they represented more nearly the methods in vogue here; but many, if not most of the tables, are available for English-reading engineers; and these alone ought to be fully worth the very low price of the work.

PUBLIC WORKS DEPARTMENT OF SOUTH AUSTRALIA: Report for the Year Ending June 30, 1892. Alex. B. Moncrieff, Engineer-in-Chief. 4to, pp. 80. Tables and plates.

This report describes in detail the operations of the South Australian Department of Public Works for the year named, including water supply and storage, irrigation and sewerage systems, the construction and repairs of jetties and lighthouses, roads and bridges, and the deepening of harbors.

A large folding colored map shows the location of the various public works in charge of the department. A diagram shows the gagings of the River Murray for the years 1891-92, and other diagrams show the strata pierced by artesian wells and the progress of dredging at Port Adelaide.

IRRIGATION AND WATER STORAGE IN THE ARID REGIONS: A Report of the Chief Signal Officer of the Army, etc., 4to, pp. 356; many tables, several diagrams and 37 colored maps or charts. Pub. Doc.

This work is of great value to those interested in the conditions affecting irrigation and water storage, and to all others who have occasion to use statistics of rainfall and temperature for the section of the United States covered by the report, as mentioned below. It was prepared by Gen. A. W. Greely, U. S. A., while Chief Signal Officer, and Lieut. W. A. Glassford, of the Signal Corps. The report was completed in 1891.

General Greely contributes 18 pages on the "Climatology of the Arid Regions of the United States, with Reference to Irrigation," in which he discusses the subject in a general and practical manner, showing by diagrams the typical curves of normal precipitation, temperature, and weight of aqueous vapor, water evaporation, and percentage of sunshine, all by months, for Arizona, California, Colorado, Nevada, New Mexico and Utah.

Then follow some 275 pages of meterological data, largely rainfall statistics from different stations, some of which are for a long term of years, and none of which extend later than the year 1890.

Lieutenant Glassford contributes separate memoirs upon the climate of Arizona, New Mexico, California and Nevada, with particular reference to the rainfall and temperature, and their influence upon the irrigation problems of these states and territories.

The colored charts in the report show in detail the climate and topography, the normal annual, seasonal and monthly extremes of rainfall and temperature of the several states and territories.

THE MINERAL INDUSTRY, its Statistics, Technology and Trade in the United States and Other Countries, from the Earliest Times to the End of 1892. Statistical Supplement of the "Engineering and Mining Journal." Edited by Richard P. Rothwell. New York, 1893: The Scientific Publishing Co.; 8vo.; pp. xxiii + 628; illustrated; price, cloth, $2.50; paper, $2.

This volume is the development of the special number, devoted to mineral statistics, which the "Engineering and Mining Journal" has made the first issue of

each year for some years past. The scope of the work is, of course, much increased beyond that of the usual annual statistical issue, being extended to include the history and technology of the different minerals, as well as the statistics of production and trade. Even a partial summary of the contents of the book is impossible. The subjects treated include: Acids, Aluminum, Antimony, Asbestos, Asphaltum, Bauxite, Borax, Brimstone, Bromine, Barytes, Chemicals and Chemical Fertilizers, Chromium, Coal, Cobalt, Copper, Corundum, Fluorspar, Gold and Silver, Graphite, Gypsum, Iron and Steel, Iron Ores, Lead, Manganese, Mica, Natural Gas, Nickel, Petroleum, Phosphates, Platinum and Platinum Minerals, Precious Stones, Pyrites, Quicksilver, Soda (natural), Sulphur, Sulphuric Acid, Tin, Zinc, etc.

In treating each subject the volume describes the occurrence and character of deposits in which the minerals are found; the characteristics of the mineral; methods of treatment; cost of mining; characteristics of metal or other products; costs; uses; statistics of production; imports and exports from the earliest times; consumption, total and per capita; review of markets; prices; foreign production, imports, exports and consumption: The several technical articles are writen by specialists, and the statistical matter bears evidence of careful preparation, and is well arranged. It may be stated that it is the intention of the publishers to issue a similar volume annually, with corrections and revisions to date.

REPORT OF THE RAILROAD COMMISSIONERS OF THE STATE OF IOWA, for the Year ending June 30, 1892. Pub. Doc.; 8vo., cloth; pp. 940.

The first 113 pages of this report are devoted to the usual complete tables of railway operations and finances which have made the reports of this commission among the most valuable of those of any of our state railroad commissions, and the remainder is given up to the returns from the several railway companies operating in the state.

AGRICULTURAL EXPERIMENT STATION OF COLORADO: Report for the Year 1891. Walter J. Quick, Director; Prof. L. G. Carpenter, Meteorologist and Irrigation Engineer. 8vo, pp. 130; tables and illustrations.

Nearly 70 pages of this volume are taken up with Professor Carpenter's report on meteorology and irrigation engineering, the most interesting part of which to engineers, perhaps, is the section on the "Return of Seepage Waters." From measurements made in Colorado, it is concluded that the return of seepage water to streams from irrigated lands is quite an important factor in irrigation. Experiments on evaporation, and on the duty of water in irrigation, which are being carried on at the station, promise contributions to the knowledge on the subject, while the observations on soil temperatures may aid in the solution of sewage disposal by means of irrigation and intermittent downward filtration.

The station is located at Fort Collins, Colo., and is a part of the State Agricultural College.

ARIZONA AGRICULTURAL EXPERIMENT STATION: Irrigation in Arizona, Bulletin No. 3, October, 1891. pp. 14. Waters and Water Analyses, Bulletin No. 4, November, 1891. pp. 16. Soils and Waters, Bulletin No. 6, April, 1892. pp. 8. Frank A. Gulley, Director; Vasa E. Stolbrand, Meteorologist and Irrigation Engineer; C. B. Collingwood, Chemist.

This station is located at Tucson, constitutes a part of the University of Arizona, and is doing some good work in the interests of irrigation.

The bulletin, "Irrigation in Arizona," relates chiefly to the irrigation works of the territory—a small amount of space being given to pumping plants for irrigation, the duty of water and the miner's inch.

"Waters and Water Analyses" is principally a preliminary bulletin outlining the proposed study of the effect of different waters upon soil. A few water analyses are given in this bulletin.

"Soils and Waters" sets forth the result of an investigation of the agricultural possibilities of the soil of the mesa, south of Yuma, Ariz., made at the request of Mr. H. W. Blaisdell, of that place, and including mechanical and chemical analyses, the former for the classification by sizes of particles only. As the land in question was to be irrigated from the Colorado River analyses of daily samples of water were made during the months August, 1891, to February, 1892, inclusive. The estimated value for the seven months of the average amount of phosphoric acid, available potash and nitrogen in one acre-inch of water is 25.2 cts The value of barnyard manure as a fertilizer per ton is given in the reports as $2.49, against 60 cts. as the value of the Colorado River sediment. It is stated that these figures do not fully represent the value of the sediment from Colorado River water, since the clay and silt in this sediment will eventually change the light sandy soil of the mesa to a fine loam capable of high cultivation. .

TRADE PUBLICATIONS.

HIGH-SPEED ENGINES.—J. T. Case Engine Co., New Britain, Conn. 12mo, pp. 27.

This is an illustrated catalogue and description of the Case automatic high-speed engine, in which the piston rod is connected direct to the crank pin, without the intervention of a connecting rod, the cylinder having a slight rocking motion. A number of these engines are in use and are of 2½ to 25 HP.

GASOLINE ENGINE.—Otto Gas Engine Works, Philadelphia, Pa. 8vo; pp. 24; illustrated.

The Otto gas engine was brought out in 1867, and since then 40,000 gas and gasoline engines have been sold, representing about 200,000 HP. In the gasoline engine the power is obtained from the combustion of gasoline and air in the engine cylinder—no vaporizer or carburetor being used; and the fuel is admitted by a poppet valve instead of a slide valve. The ignition may be effected by an electric spark or gasoline torch and heated tube. The average consumption of 70° gasoline is about one gallon per rated horse-power The engines are made from 3 HP. to 65 HP.

GEARING.—Robert Poole & Son Co., Baltimore, Md. Cloth, 12 mo. pp. 206, illustrated.

This is an illustrated catalogue of gearing of various kinds—spur gears, bevel gears, miter gears, worm gears, etc.—with lists of the various sizes arranged according to pitch. The company makes a specialty of machine-molded gears, using a grade of iron specially suited to the purpose, but not suitable for cut gears. The plant, however, includes all tools and equipment for the manufacture of cut gearing, and for spacing, cutting and planing gears of all kinds, up to 50 ft. diameter. Band, rope and fly-wheels, chain sheaves, turbines, friction clutches, etc., are also manufactured. The book includes several pages of general information and tables in relation to areas of circles, expansion of metals, specific gravities, etc.

SOCIETY PROCEEDINGS.

AMERICAN INSTITUTE OF ARCHITECTS.—A meeting of the Executive Committee was held in the rooms of the New York Chapter, 18 Broadway, April 10. The president and secretary were directed to send a communication to the Secretary of the Treasury in regard to the operations of the bill in relation to procuring designs for public buildings, and from the reports of those who have interviewed the secretary it is believed that the provisions of the bill will be carried out in such a manner as to ensure a fair trial of its value. Plans were discussed for the next annual convention, which will be held in Chicago in conjunction with the International Congress of Architects, in the week beginning July 31.

Alfred Stone, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on April 19, Mr. C. B. Brush, Vice-President, in the chair, two papers were read, on "The Old-Time Water-Wheels of America," J. P. Frizell, and "The Cost of Operating Cable Railways," by D. Bartecou, as noted in our issue of April 20. In the discussion on early forms of water-wheels, Mr. Collingwood referred to cast iron wheels, not over 4 ft. diameter, with curved buckets, used about 1845, and Mr. Dodge briefly described some old iron wheels with flat floats or buckets between inner and outer rims, against which the water was directed at an angle of 45°; these were largely used for sawmills. Mr. Nichols referred to the large wheel at Troy, N. Y., 20 to 25 ft. face, utilizing a small flow. The use of paddle wheels on boats anchored in the Seine, at Paris, to drive light machinery was described by Mr. LaValles, and Mr. Parker referred to current wheels for raising water for irrigation in Colorado. Mr. T. C. Clarke said that turbines have superseded water-wheels as the age of iron has succeeded the age of wood.

In the discussion on cable railways and rapid transit, Mr. North presented a tabular record of the cost of horse traction, and stated that the cable system, in competing with horse traction, has to meet the interest on cost of construction. Mr. Leverich alluded to the difficulty of obtaining reliable information upon which to base comparisons of cost of operation of different systems. Mr. T. C. Clarke said that in Chicago the cost of operation of the cable lines is about half that of the horse-car lines, and the same result is obtained on the elevated railways of Boston. Both cable and electric roads have a greater earning power than horse-car lines, owing to the greater capacity of speed of the cars when beyond the crowded streets. Mr. Brush referred to the elevated cable railway at Hoboken, N. J., which has been in operation for ten years, and has a grade of 5½% for 1,500 ft., the total length of the line being about 2,000 ft.; on the elevated extension of this line, which is practically level, electric traction was used, and proved so successful that it was tried on the steep grade, and eventually the cable was entirely abandoned. The traffic is handled with greater facility, and the economy in cost of operation is very marked. The life of the cable was from 9 to 14 months. The electric cars have motors on the axles, and can haul trail cars. The dvantages of high-speed suburban cars were shown by the fact that the traffic steadily increases, although the line parallels a horse-car line only a block distant. Mr. Brendlinger said that at Yonkers the street railway was formerly operated by horses, the speed was very slow, the service poor, and the traffic light, as people generally preferred to walk. When the trolley electric system was put in, the cars ran at higher speed, and were soon crowded, and the result of this is that people are now living farther out from the town. Mr. Dodge said that a horse-car system developed the city proper while electric and cable systems developed the suburbs, and, up to a distance of about ten miles, competed seriously with steam railways, as shown by the competition of steam and electric railways between St. Paul and Minneapolis. Mr. Clarke said that where electric and steam roads compete, the former have the advantage of a constant service, while the steam roads have trains at longer intervals, and persons using them must regulate their movements by the time-tables.

At the meeting on May 3, a paper will be read on "The Improvement of the James River."

The following circular has been issued in regard to engineeers visiting New York in connection with the World's Columbian Exposition:

The Board of Direction has appointed a Committee of Information and Courtesy, consisting of Messrs. Edward P. North, L. L. Buck and Foster Crowell, with headquarters at the Society House, to extend to visiting engineers during the World's Columbian Exposition information and guidance to enable them to gain convenient access to works and objects of engineering interest throughout this country. It is hoped that you will aid the committee in this effort by communicating to it information as to works of either engineering or manufacturing interest, under your direction or in your vicinity, of which you have knowledge, and by extending facilities to visitors who may come to you properly accredited from time to time during the continuance of the Exposition. It is to be understood that the acceptance of this duty entails no pecuniary outlay by yourself. The committee has been constituted on the most economical basis consistent with the object, and in order to carry out the plan must rely largely on the voluntary services of members of the Society on the lines above indicated. If you are willing to co-operate please address Committee on Information and Courtesy, American Society of Civil Engineers, 127 East Twenty-third St., New York, giving information in detail, and stating at the same time what foreign language you may personally or through others have at your command.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on April 20, a paper on "The Results of Tests of White Pine of Large Scantling," was read by Prof. Henry T. Bovey, and the discussion on Mr. J. S. Armstrong's paper on "Transition Curves" was resumed.

C. H. McLeod, Secy.

COMING TECHNICAL MEETINGS.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 1. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
May 2. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
May 3. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 3. Secy., F. Collingwood 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
May 3. Secy., Arthur Thacher, Odd Fellows' Building.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 4. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
May 5. Secy., F. K. Smoot, 508 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 5. Secy., O. Van Geldern, 719 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
May 6. Secy., P. Valentine, At 281 Union St., Brooklyn, and 446 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
ENGINEERS' CLUB OF PHILADELPHIA.
May 6. 1122 Girard St. Secy., L. F. Rondinella.
WISCONSIN POLYTECHNIC SOCIETY.
May 8. Secy., M. F. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
May 8. Secy., Waterman Stone, Baird Building.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
May 9. S. W. Spear, E. Buffalo, N. Y., Iron Works.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 9. Secy., F. C. Osborn, Case Library Bldg.
DENVER SOCIETY OF CIVIL ENGINEERS.
May 9. Secy., F. E. King, Jacobson Block.
NORTHWEST RAILROAD CLUB.
May 9. Ryan Hotel, St. Paul. Secy., W. D. Crosman.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 9. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
May 10. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
May 10. Secy. F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
May 11. Secy., F. W. Mowbray, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 11. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
May 12. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 13. Secy., F. D. Jones, Helena.
COLUMBIAN ENGINEERING SOCIETY.
May 16. Secy., F. W. Hart, Washington, D. C.
WESTERN RAILWAY CLUB.
May 16. Secy., C. F. Street, Rookery Building, Chicago.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16. Secy., R. H. Clark, Pittsburg.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 17. Secy., L. V. Carmalt, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 17. Secy., S. E. Tinkham, 36 Broomfield St.
NEW YORK RAILROAD CLUB.
May 18. Secy., H. G. Prout, 73 Broadway, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
May 18. Secy., J. F. Wilson, 24 W. 4th St.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
May 18. Secy., C. F. Franson, Portland Block.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
May 19. 201 Washington Building.
CENTRAL RAILWAY CLUB.
May 24. Secy., S. W. Spear, Buffalo, N. Y.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 26. Secy., C. H. McLeod, Montreal, P. Q.
AMERICAN RAILWAY MASTER MECHANICS ASSOCN.
June 19 Lakewood, N. Y. Secy., Angus Sinclair New York

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AND

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CHAS W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

Chicago Office: Monadnock Building.
F. A. PECKHAM .....MANAGER

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ADVERTISING RATES: 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements, not later than Wednesday noon. The last pages go to press early on Thursday. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

An interesting indication of the development of electric traction is the substitution of electric for cable traction on the steep grade elevated railway in Hoboken, N. J., which makes the ascent from the ferry to the heights, the maximum grade being 5½%. In the discussion on the cost of operation of cable railways at the meeting of the American Society of Civil Engineers on April 20, as noted in another column, Mr. Chas. B. Brush stated that on the elevated extension of this line, along the high ground, electric traction was adopted and proved so successful that it was decided to try it on the heavy grade. For a time the cars were run by electricity only during the hours of light traffic, the cable being used at other times. The results were so satisfactory, however, that the cable traction was entirely abandoned, and the line worked by electric power alone, facilitating the handling of the traffic, and effecting a decided saving in cost of operation. Two other interesting facts noted in this discussion were the increase of traffic due to the higher speed of electric cars, and the advantages which an electric railway has in competing with the suburban traffic of a steam railway, for while the former gives its patrons practically a constant service, the latter runs trains at long intervals, requiring its patrons to live up to a regular timetable.

Some experiments on the effect of heat in causing leaks in boiler tube-plates are described, in this issue, in a paper by the Chief Engineer of the British Navy. A very interesting feature of the experiments was the effect of grease on the surface of metal in hindering the transmission of heat and thus causing overheating of the metal. It was thoroughly proved that even a very thin coating of grease will considerably retard the transmission of heat. This is, indeed, no new discovery, but it is a fact which is not as generally known and appreciated as it should be, especially by those who use kerosene or other oil to loosen the scale in boilers. The merits of kerosene in loosening scale are undeniable; but after using, it should be thoroughly removed from the boiler before it is put in regular service. The overheating of plates has sometimes been traced to the neglect to observe this precaution.

Another interesting feature of the experiments was the very high temperature required to cause leakage of tubes in an experimental tube-plate. Various experiments made in different ways proved conclusively that a temperature of 800° to 1,000° was required to cause leakage of the tubes in the plates. It was also shown, however, that a small amount of oil in the feedwater would cause a tube plate to be heated to this temperature, and leakage of the tubes would result.

The net result of the experiments cannot be said to have thrown much light on the causes of leaky tubes in marine boilers, which have given so much trouble in the British Navy. The experiments seem to show that tubes should not leak except under very severe conditions, whereas experience with actual boilers has shown that they do leak under very slight provocation. The only remedy which has been hit upon is the insertion of ferrules in the tubes (not external ferrules between the tube and the plate, as in locomotive boiler practice). These ferrules simply act to hinder the transmission of heat to the ends of the tube and the plate and keep it at a lower temperature than would exist if the ferrules were not present. Of course, they burn out rapidly and require renewal at frequent intervals; but they appear to be the best solution of the leaky tube problem which the English engineers have thus far found, and they are being rapidly applied throughout the British Navy.

The Auditor of the World's Columbian Exposition at Chicago reports, to March 31, that the sum of $16,708,826 had been expended upon that enterprise, and that $14,411,506 represents the amount spent upon buildings, etc., coming under the direction of Mr. Burnham, Director of Works. What this total means can best be understood by comparing it with the money expended upon the exhibition grounds and buildings of previous world's fairs, bearing in mind the fact that these exhibitions have constantly grown in space occupied and the number of exhibitors, and that in area of grounds and number and splendor of its buildings and appointments the Chicago fair exceeds all previous efforts in this direction. Details of the expenditures were given in our issue of Feb. 23. From such records as are at hand we find that the total expense of the London Exhibition of 1851 was $1,424,882, and the main building represented $694,810 of this amount. The three buildings of the Paris Exhibition of 1855 cost about $3,495,000; the buildings for the London International Exhibition of 1862 cost $2,092,595, and the total amount raised previous to the Paris Exhibition of 1867 was $5,883,400; but just what part of this was spent upon buildings and grounds is not stated. The Vienna Exhibition of 1873 was a financial failure, owing to prevailing hard times. The Austrian government appropriated only $3,000,000, while the total expenses were $12,000,000, including the buildings and grounds. The result was a deficit of $9,000,000, as the attendance barely paid the running expenses. The buildings erected by the Centennial Commission of 1876, in Philadelphia, cost $5,242,295, while $922,782 in addition were expended in grading, draining and fencing the grounds, in bridges, etc. The cost of the buildings for the Paris Exhibition of 1878 is not available; but the sum of $9,000,000 was appropriated for the total expenses, and the net returns at the close of the exhibition showed a profit. The actual cost of the three main structures on the Champ de Mars for the French Exposition of 1889 was $3,957,714; and the total amount of money available, from the national government, the city of Paris, sale of bonds and concessions and from exhibits by the nation, was $11,069,562.

Fuller comparative data, relating to the Chicago fair and its important predecessors, will be found in our issue of Jan. 30, 1892; and it can only be added that the scale of the Chicago exhibition, with its work carried on with very slight aid from the government, proves the abiding faith of its projectors in the interest the perfected exhibition will awaken in the people of the United States, and in its value as a national educator. That such a sum of money could be raised for an enterprise that is to last only six months is in itself a telling exhibit of our growth in material prosperity since 1876; and the character of the buildings and their decorations show as marked an advance in artistic feeling in the people of this country. From both a structural and an artistic standpoint the buildings erected at Chicago will exceed any ever constructed for a similar purpose, and they will be in telling contrast in this respect with the similar effort of American builders in Philadelphia in 1876. There was abundant room for this advance, we must admit; but there is some satisfaction in feeling that not only at the Chicago fair but in almost every household in the land there is evidence of a healthy growth in artistic feeling and a demand for the best that the world can provide in this direction, which demand can be traced back in great part to our previous international exposition. If the World's Columbian Exposition teaches the people of the United States as much as did the Centennial of 1876 it is worth all that it costs, no matter what the ultimate sum may be.

The dismal reports of breakages of some kinds of couplers and knuckles, which circulated about a year or two ago, are within the knowledge of all our readers interested in that subject, and did much to discourage those who were anxious to see automatic couplers rapidly introduced, and still more to discourage those who favored the use of cast steel for knuckles or couplers or both; since it was evident that if cast steel was not good enough to make good knuckles, still less was it likely to be good enough to make good couplers.

That a great and most gratifying change has taken place since that date we have lately seen conclusively proved, by having a chance to see many hundred knuckles and couplers broken, not (as may will be imagined) for the mere sake of making an exhibition of their qualities to secure public notice, but as a part of some legal proceedings which made it necessary to secure evidence of quality on a large scale and in a fair way. Whether all coupler manufacturers, or any of them, are now getting steel knuckles of as good quality as are on the market, we have no means of knowing, and if we knew should hardly like to say unless we could say that all steel knuckles made were of equally good quality; but we can say at least that steel knuckles are now made which are of superlatively good quality, most of them being practically indestructible under a 15-lb. sledge wielded by a powerful man striking on the lower lug, which is deeply nicked, and looks almost as if made to make it easy to break off, by foul blows of this kind, in a direction where there is no strain in service. Therefore, if any company is not now getting entirely satisfactory steel knuckles, it is its own fault. The article is on the market, and can be had by those who will take pains to secure it.

On the other hand, old steel knuckles, of the kind from which these complaints of bad quality came, were broken by hundreds at the same time, and there was hardly one in a hundred which would not break at once under a single blow when lying on the soft ground, instead of in a cast iron striking block. The strongest knuckle out of many hundred broken required 22 blows to break it, and the next strongest, eight. Such a showing went far to reconcile one to the attempt of some of the New England roads to substitute cast iron for cast steel knuckles in coupler repairs, for we are of the opinion that any good quality of cast iron would have shown more toughness under blows than this cast steel.

In contrast with this, the present make of knuckles showed distinctly greater toughness and resistance to blows than any wrought iron could be expected to do, so far as one may fairly judge without an actual trial, for although wrought iron would hardly break under similar abuse, it would, in our judgment, bend much more readily and upset much more. Perhaps the most convincing exhibition of quality was of a knuckle which chanced to crack at the 40th blow. It took 15 more blows on the cracked knuckle before the crack opened to extend clear through an inch or so of metal to the pin hole, and after it had thus half broken off, 55 more blows, or 110 blows in all, failed to start the slightest crack on the other side. Fully three-fourths of the knuckles, however, would stand 100 blows without any sign of fracture. It is difficult to compare such blows with the effect of blows in service, which are, of course, much heavier, but strike the knuckle more fairly and are eased by the springs. We should say, however, that 20 such blows tried a knuckle as severely as it was likely to be tried by 10 years of service on the road.

The effect of this exhibition was to convince us that not only had the ideal material for knuckles been found, but that it was likely to prove the

cheapest and best material for couplers also. Nothing short of armor steel could have been expected to do better. Therefore, it is of less interest to note the progress shown in malleable couplers, though that also was notable. The malleable coupler has been so perfected as to be well equal to its duty, if no better can be found, but we look with some confidence to see cast steel gain steadily upon it, as cheaper and equally good, with more possibilities for advancement.

THE IDEAL ENGINEERING SCHOOL.

It is impossible to spend a year or two in ascertaining and working up facts in regard to our training schools for engineers, after having spent 25 years or so in the actual practice of engineering, without reaching some conclusions as to "the ideal engineering school," and wherein the real ones fall short of it. The natural egotism of man under such circumstances is apt to lead him to believe that conclusions thus reached may have possible value and utility. Thus influenced, we propose to give in this and one or more succeeding articles such impressions as we have derived from the preparation of the series of articles on engineering schools, which has recently appeared in these columns, both as to what is and what should be. We shall do this not dogmatically nor as a finality, even in the mind of the writer; but in intent at least suggestively and helpfully, though with all necessary frankness to accomplish the end, even when it might be pleasanter to speak less frankly.

A striking fact which confronts one at the very beginning of such an inquiry is that, although engineering education is to-day a vast and growing interest, it is after all a thing of yesterday. Hardly a man at the head of any of our engineering schools has failed to see its rise from (practically) nothing within his own active life. The very profession for which it is designed to prepare is itself hardly older. Men who were almost its earliest practitioners in this country are still living. Individual men of genius who have executed great engineering works have existed in all ages, but until recent years they have always been untaught or self-taught geniuses. As a profession which had been reduced to set rules and principles which had become of record and could be taught in schools, and which were actually practiced by any considerable body of men, engineering in this country does not date back of 1830 and hardly back of 1850.

In Britain it is somewhat but not much older. On the continent both engineering and engineering education date back in a formal way to a still earlier date. But we may say now in advance that we do not propose to discuss European engineering schools also, partly from lack of knowledge of them, and partly because we think the end in view will be better secured by neglecting their precedents altogether. The English-speaking race taken together controls and carries on a full two-thirds of almost every kind of industrial and constructive enterprise in the world. Their practice in almost every one of these is rather in advance of continental practice. They have a right to conclude that their methods or their natural aptitude or both are superior to those of the other European races, and hence that methods and practices which they neither use nor can find a reason for in their own conditions are probably not in fact well suited to their needs. This rule should not be extended to details, as to which something can always be learned from other nations; but in dealing with broad principles, which alone we propose to consider, it surely applies.

As between Britain and the United States, we have as little reason to go abroad for instruction as to general principles. While there are two or three very excellent British schools, our own are as a whole far in advance of them in number, magnitude, wealth and number of students, not to enter upon the invidious question of quality of instruction, as to which also there is good reason to believe that we are notably in advance of them, comparing school by school in order of recognized merit, with one or two possible exceptions.

This newness and rapid growth both of engineering as a profession and of education therefor is a primary fact which should not be lost sight of. It makes it entirely possible that all our schools are organized more or less upon wrong lines, though there has not yet been time to recognize and correct the evil. One school doth tread upon another's heels, so fast they follow; and what can each new one do but copy from the "old" ones as it finds them? And what can each old one do when it finds an enormously rapid growth in the number of students who seek the education it has to offer, but conclude that what it offers is about the right thing, and that anyway it finds it hard enough to keep up the quantity and quality of the article it is furnishing, without hunting about for some other or different article which it might furnish?

The great scale upon which our engineering schools are organized, therefore, and their substantial uniformity of method, if shown to exist, while a perfectly valid defense against blame to individuals and individual schools for any defects of method which may be found, yet does not prove nor tend to prove that serious defects of method may not exist; because it is undeniable that the present great and growing demand for engineering education comes primarily from opportunities which exist outside of the schools and not within them. The incredibly rapid industrial development of recent years has driven men in shoals to seek and to offer whatever training for a future captain of industry was to be had at the moment, without stopping to wait for the slow development of centuries which has shaped educational methods for the older professions.

We have been thus careful to indicate how pardonable we feel it to be that imperfect methods should exist, if they do in fact exist, because we may say at once that we hold the training given in every one of our engineering schools to be in some important respects radically and unnecessarily defective, and in establishing that fact (as we expect to do to the satisfaction of engineers, if not of engineering educators) we may have to say some things which might otherwise sound like overt or covert reproaches of individuals. Nothing is further from our wish or thought.

Let these fundamental facts then be kept in mind: Engineering as a profession is a thing of yesterday; education therefore is still younger; the demand for training in it has multiplied so fast that there has been neither time nor necessity to develop with care ideally perfect methods. Therefore radically imperfect methods may exist and be practiced on a pretty large scale without any reproach to individuals, and without creating any strong presumption that they are therefore right.

These preliminaries out of the way, let us first orient ourselves with reference to the other professions, and get what light we can as to engineering education from analogy with other kinds of professional training.

Excluding the artistic professions, which stand apart from the present issues, four professions only antedate engineering and all of them are of great age—law, medicine, divinity and the profession of arms. By the term "profession," without now entering into any hair-splitting distinctions, we mean a calling which implies and demands an intellectual training of some kind, and a continued intellectual activity. The profession of arms hardly implied that in old days; it demanded chiefly physical prowess, but for a century or two at least much more than this has been demanded of those standing high in it, and in recent times it has become a highly specialized and highly trained profession in all its ranks, and no one without prior professional training of a technical kind has been able to compete in it on equal terms. Moreover, as we shall shortly see, it is a more instructive profession for indicating by analogy what the training of an engineer should be than either one of the other three.

The other three professions present the striking contrast with engineering that (with minor limitations to be noted) they are purely and wholly intellectual callings, which may be taught in their highest development by purely intellectual processes in schools only (by taking time enough), and which require for their most successful practice only self-centered and strictly personal mental acquirements and aptitudes. All we ask of a lawyer is to know the law and (or "or") to be apt in expounding it convincingly. He need have no training nor aptitude of any kind for dealing with men or with things outside of the courtroom. He need not be personally agreeable to his fellow practitioners or to the public. He is wanted for that one thing, an intellectual keenness and a knowledge of certain books and of their proper use; and he may be anything or nothing otherwise.

Accordingly, we find three facts to be true about law schools which are not true at all about engineering schools: 1. The training given and required is (properly enough) purely mental, including under that head oratorical training. When all has been done which can be done of mental work in a single year the school has done all it can for the student and may close its doors for that year.

2. The better fitted a man is to practice law in any particular branch the better fitted he is to teach law in that branch, as it is actually taught in the law schools. Not only in his preliminary training but in his subsequent practice, he is continually fitting himself better and better to teach law in his special department by practicing it.

3. The better fitted a man is to teach law in the actual law school the better fitted he is (except in one respect) to practice law in his special department. Both occupations are in their essence the same, the handling and balancing against each other of certain records and abstract principles; but in teaching law a man has only to deal with the intellects of boys, whereas in practicing he has to contend against the intellects of men; an important distinction which works somewhat against the fitness of an old professor of anything to practice it, though not (in the same way) against the fitness of an old practitioner to teach it. There have also grown up in recent years sub-departments of patent and other technical law, in which almost any kind of technical knowledge a man may have will come in usefully. But this technical side of law is of very recent origin, as recent as the technical professions, and all general rules must have partial exceptions. Broadly speaking, law is a purely intellectual profession as described; and there is nothing to prevent a man from teaching and practicing it interchangeably.

Whether for this reason or because long experience has established the fact that the best practitioners of law are also the best teachers, it is a fact that the teachers of law are in no sense and in no degree a class apart from the practitioners. The latter and the latter only are drawn upon to fill the important professorships, and generally, only after a long career of pretty successful practice. To a very large extent also they continue active practice concurrently with the work of instruction, and find each no hindrance to the other except in the time demanded for it.

The same, with hardly the change of a word, applies also to the profession of divinity. Of course we do not now consider the moral, social or religious qualifications which are required for that profession, but look at it purely from the intellectual side. The majority of church-going people being men of affairs it is of course a help to a clergyman if he has more or less of a practical side to him as well as good social qualities. The latter have much to do with all men's success, and especially with a clergyman's. But, after all, the chief essential for mere worldly success in the ministry is a certain abstract intellectual training and a good flow of words. He who has that may succeed in it with very little of inward and spiritual grace. The reverse is not true.

It is natural and inevitable, therefore, that ministerial education should be formed on much the same lines as for the law, and it is so in fact. Here also the training is purely intellectual; its only end is to train the individual man for work which he carries on alone, from his own individual resources, and not as one of a group to which he contributes one grade of work and knowledge and some one else another. No one needing a lawyer or minister at all wants any but the best if he can get it. If he puts up with less it is because he cannot help himself, and what makes a man the best is a self-centered intellectual training.

So also in the profession of medicine, what chiefly determines a man's professional rank is a self-centered intellectual training; and no one wants any physician but the best if he wants any at all. The surgical side of medicine demands a certain manual training and dexterity, but that in itself is as purely mechanical as the skill of a cabinet-maker. What makes it such high and responsible professional work is the intellectual training which must accompany it combined with the serious conse-

quences which follow any lack of manual dexterity. That dexterity, like any other, is to be acquired only by long practice. As with any other kind of manual dexterity practice at first results in rapid advance, but a maximum is soon reached beyond which few men can advance much, and they but slowly.

The training of the mind of the surgeon, however, like that of any other professional man, continues through life, and has no real limit to it other than the mental powers of the individual. Speaking now only of this training, it is almost as purely intellectual as in divinity or law, only, instead of being confined to reading and studying books, they have to read and study both books and the human mind and body, draw certain conclusions therefrom, and act accordingly.

This, however, does make one distinction between medicine and the other two professions which tends to assimilate it to engineering, and which we may as well note here. There being two distinct kinds of training required, there is no prima-facie reason why, after the study of books has been carried as far as is feasible in any one year, the remainder of the year (or any part thereof) should not be devoted to practice or to study of the human body, and yet we do not find as a matter of fact that any larger portion of the year is devoted to professional study in medical schools than in law or divinity schools.

But there are some very good reasons for this. Practice, properly so-called, in any department of professional work, the young medical student cannot have until he has graduated. So much consideration is shown for patients and possible victims of his zeal. Even after he has graduated, only a select few can be admitted to duty in the hospitals; if so admitted, they are put through a severe course of training for but little compensation. Dissection of the human body is eminently unsuitable for summer work, and should be carried on simultaneously with book study. Numerous clinics in operative surgery are important only to the few who are to become surgeons, and moreover, the leading professors, being almost to a man eminent practitioners who carry on coincidently with the work of instruction a large private practice and enjoy a large private income, are away during the summer and will not give instruction of any kind.

Without further enumeration of details, we have said enough to show that these main characteristics are common to all three of the old learned professions. The training is and ought to be almost purely intellectual. It is purely personal to the individual. The individual's professional success depends only or chiefly on his personal ability to pursue a narrow if very long path of abstract study, regardless of his relations to the rest of mankind except in this path. Practice in any one of these professions does not unfit a man for teaching it, but the contrary. Teaching in any one of them does not unfit a man for practicing, but the contrary. Teachers of any one of them are as a matter of fact chosen only from old and successful practitioners, with rare exceptions. These to a large extent find that teaching and practice help each other, and combine the two. Of training in any kind of practical work or in knowledge thereof, outside of the strict line of intellectual training, none is either given or required.

We will now see what instruction by analogy is to be had from the profession of arms. Before doing so, however, we will note as a fact, for what it is worth, that the organization and the control of our engineering schools has been and is almost wholly in the hands of those who have derived their ideas of proper methods of professional training from inherited or acquired experience in teaching the three old "learned professions," between which and the new profession of engineering it will be clear that there is rather contrast than analogy in many important respects. We will also note for what it is worth another fact: Whereas the whole work and practice of instruction in the three old professions is carried on or controlled by the leading practitioners in those professions, the work of instruction in engineering is and has been only to a limited extent carried on and not at all controlled by leading practitioners or ex-practitioners of engineering, with exceptions only numerous enough to prove the rule.

None of the American magazine rifles have so far successfully stood the severe tests to which they have been subjected by the Otis board, at Springfield, Mass. The White gun, from which so much was expected, failed from a defect of manufacture, and may be repaired and subjected to further test. In the trials, the endurance test consisted of 600 rounds, and the dust test of 40 rounds. The test of excessive charge was 40 grs. of powder, or 3 grs. beyond the usual charge. Two guns still remain to be tested, while 12 have failed from accident and 1 was withdrawn.

A powerful steel and iron manufacturing syndicate is said to be in process of organization which will rival in magnitude the combined Carnegie interests. James Harvey, the inventor of the famous nickel-steel and Harvey process of hardening steel, is credited with being the projector of the syndicate, and with having interested heavy capitalists from many of the prominent cities of the United States to the extent of $100,000,000. The site of the works will probably be near Pittsburg, Pa., and, as Mr. Harvey is said to be dissatisfied with the royalty now paid him by Mr. Carnegie for his armor-plate patents, the new company may take to itself exclusively this manufacture.

The official report on the trial of the Sponsel rapid-fire gun has been made public by the Navy Department and is in every way favorable. The breech mechanism was put in place in 32 seconds, after it had been taken out. Five rounds were fired in 12 seconds by an inexperienced man; and 10 defective cartridges, with the primer thinned down to test the firing pin, were then discharged with a great leakage of gas, but no other effect. Without cleaning, 60 rounds were then fired in 3m. 36s. The Navy Board reported in favor of the strength and endurance of the breech closure and the efficiency of the breech mechanism; that the action of the extractors was all that could be desired; that the working parts could be quickly dismounted and assembled without tools, and that all the breech mechanism was contained in the breech-block and could be taken out or replaced at one time. Three men can serve the gun effectively, and with a little practice the rate of 25 shots per minute can be considerably increased. The range of the gun was about 3 miles, with effective penetration up to 2,500 yds. On this gun the breech-block contains only 19 parts, including the block itself. And owing to its simplicity the inventor, Mr. Charles W. Sponsel, of Hartford, Conn., says that the gun can be built for 20% less than other rapid-fire guns now in use.

The announcement that the Pennsylvania Steel Co. has been placed in receivers' hands comes as a surprise to all save those having intimate knowledge of the company's financial affairs. The company was organized in 1865, and began the manufacture of Bessemer steel at its works at Steelton, on the Susquehanna River, near Harrisburg, Pa., in 1867. The first rails were rolled in 1868, and the manufacture of billets, slabs, blooms, plates, structural shapes and railway frogs and switches has been undertaken at various times since, the works being gradually enlarged until they now give employment to over 3,700 men and have a daily output of about 1,200 tons of steel in all shapes.

The fact that the Bessemer ore used at the Steelton works was chiefly imported from Spain, Africa and Cuba, led the company, in 1887, to undertake the extension of its facilities by the establishment of a plant on the seaboard at Sparrow's Point, near Baltimore. These works were planned to include a steel rail mill with a capacity of 300,000 tons to 400,000 tons per annum, for working the output of four 18-ton Bessemer converters; and an open-hearth furnace plant whose product would be rolled into plates, structural shapes and sections for shipwork. A shipbuilding plant of large size, and containing all modern improvements, was also projected, with the foundry and machine shops necessary for building marine engines for the vessels. At the present time four blast furnaces and the Bessemer plant and rail mill, with the foundry and machine shops, are completed and in operation, and the shipbuilding department is so far advanced that some work has been turned out.

The financial embarrassment of the company is stated to be due to the large amount of capital which has been absorbed in the development of the Sparrow's Point works, much of which has of necessity been comparatively unproductive while the works were under construction. It seems, also, to have been a technical mistake, in view of the relation between supply and demand in the steel rail trade, as shown in our editorial of April 31, to have completed the steel rail plant first instead of the open-hearth and structural plant or the shipbuilding plant.

The assets of the company are, from all accounts, far in advance of its liabilities; but the lack of ready money to meet maturing obligations incurred on account of the Sparrow's Point works has necessitated the temporary placing of the plant in the hands of receivers.

LETTERS TO THE EDITOR.

LETTING HIGHWAY BRIDGE CONTRACTS.—WHAT THE BRIDGE COMPANIES THINK.

Sir: When we organized this establishment we thought of doing something in the way of building highway bridges, but we soon found that there was so much rascality and trickery in the letting of such work that we abandoned it, and now we seldom touch it except in special cases where the contracts are large and the work heavy, or for railroads for carrying highways across their tracks.

The practice of pooling we regard as a sort of robbery, and the practice cannot be condemned in too strong terms. We are glad to know that the subject is receiving marked attention, and we hope it will be completely broken up. All honest bridge-builders will be glad to have this done, not only on account of the criminality of it, but also because it is a temptation for small manufacturing establishments who are not legitimately in the business to pose as bridge-builders and send agents out simply to get a share of the boodle. This, of course, involves, in such establishments, the necessity of buying a few tools, so that they can build some bridges, in a very imperfect manner, and are enabled to pass themselves off as bridge-builders. The result of this is that they dabble into all sorts of work in the line of bridges and kindred structures without knowing much about it, and when placed on a competing basis bid generally below cost, which always has a demoralizing effect on legitimate business.

The remedy, it seems to us, is the enactment of laws in each state establishing the office of State Engineer of bridges, who should be a man of practical experience, who knows what a bridge is; not a so-called engineer, but an experienced engineer in the special line of bridge-building. It should also require country commissioners and boards of public works in cities to employ a competent engineer on all their bridgework to prepare plans and specifications—the more in detail the better—on which they shall receive bids. The engineers should all be competent and experienced bridgemen, and before such plans and specifications were submitted to bidders, they should have the approval of the State Engineer; the idea being that the plans and specifications shall be so complete that they can be sent to bidders at a distance who can send their bids by mail if they so desire.

The same law should require that no information should be given to bidders, as to who is bidding or what bids have been received, etc. A bid by mail usually upsets any pooling arrangement.

Yours truly, * * * * *

Sir: There seems to be great misapprehension in the minds of many people as to the highway bridge business; as to the pools; as to the profits, and as to the desirability of engineering supervision.

For something like 25 years it has been my privilege to read articles in the technical journals reflecting on the highway bridge-builder. About a year and a half ago a committee of the Western Society of Engineers presented a report on the subject made by a committee of which Mr. O. Chanute, then President of the American Society of Civil Engineers, was Chairman. This report, coming from such a source, and reflecting, as it did, on the highway bridge-builder and his work, called forth a response from the President of a leading Western bridge company. The substance of this reply, which was published in the "Journal of the Association of Engineering Societies," for February, 1892, is a good answer to much of the discussion which has been carried on by your correspondents.

As to your editorial in Engineering News, of Feb. 16, I will say that it is fair; but the basis for much of it appears to be uncertain.

That there is a larger percentage of pools in connection with contracts for highway bridges than for railroad bridges, or in any of the various kinds and classes of business of the country, I do not believe; and my chances of observation are, to say the least, average. Our business of bridge-building for the year past has been almost exactly one-half highway and one-half railway work. To give you an idea from our experience why I think you have written too much of pools, I will say that with us pools have amounted to a trifle less than 1.6% of the total amount of our business during the past year.

As to profits there is not a single concern doing a highway bridge business of $100,000 per annum or more in the United States that can show a net profit on its work for either of the past three years of more than 5% per annum.

Concerning engineering supervision of the building of highway bridges of the country, what proportion of the members of the leading society of engineers of the country are qualified by knowledge and experience to give counsel that really is worth anything in the building of a highway bridge for the average country community?

Your editorial assumes that engineers are at hand

to do this work, but will you attempt to name 100 men outside of the contracting field, of all the 70,000,000 people of these United States, whom you will attempt to say it would be good judgment to put money on as counsel in letting a contract for a simple highway bridge? Can you name 25? If so, please give us something that will outline what the knowledge or experience shall be to justify a community paying money to an engineer as counsel. This, I think, is the real germ of the question. I am emphatically disposed to think that if any community could get the services of a competent engineer at moderate cost, it would be very desirable.

It has been repeatedly charged that public boards are lacking in common sense. If you required the counsel of a lawyer or a doctor, how would you know you were getting the best skill? If you were a member of a county board, wanting to build a 100 ft. span across a creek, how would you select an expert engineer for this work and know that you had the right man.

The idea that the average township or county board can be "worked" more conveniently than the engineer is, in my judgment, a very great mistake. That the engineer has any more personal integrity than a member of the board, there is nothing in what has gone before to prove. The claim is "woosey." In that connection (it may be bad taste to refer to it), but the first article of the discussion in your paper is printed on the same page with an article telling of M. Eiffel, the great French engineer, as a boodler.

I ask in all fairness, if the Engineering News had to build a 100 ft. span highway bridge, and had a $1,200 appropriation for the purpose, do you think you could do it better than a county board which had contracted for and had built 100 such spans? Is it not rational and reasonable to accept the fact that the designer and builder of a country highway bridge has got to be the same person, for exactly the same reason that the architect of the country house is also the carpenter that builds it?

I apprehend that to many of the bridge-builders the discussion is a weary waste of words. Most of your correspondents, seemingly, are gentlemen who imagined from the stories they had heard that there were millions in the pools connected with highway bridge building; but upon going out to partake they have met difficulties which have led them to conclude that the business should be reformed.

In my opinion, the best way to start a bridge reform is to increase the appropriation for each bridge, so that a better bridge can be built. Finally, it is a mistake to suppose that the average highway bridge is a worse or more dangerous structure than the average railway bridge. The highway bridge is not built with as heavy material, but it is so built as to do its work with less fatigue. Yours truly,

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THE USE OF GOATS FOR PUDDLING AT THE SANTA FE DAM.

Sir: In reference to your mention of the use of goats for puddling the reservoir dam at Santa Fe, in your issue of April 13, 1893, I desire to make a correction.

The paper read by Surveyor-General Hobert, before the American Society of Irrigation Engineers, gives the time occupied by the goats in puddling as from 12 m. to 1 p. m., and from 5 to 6 p. m. This was correct when the paper was read, for at that time several hundred goats were proposed to be used, and not 115, as mentioned.

It was subsequently found that as the travel of the goats did not interfere with the teams, it would be more convenient and economical to use a less number of goats and keep them at work all day. As a result of our experience, we find that 115 goats by constant use would do well the puddling for 30 wheel scrapers, averaging about 14 cu. ft. per load on about 500 ft. haul.

The material was first spread while dumping, next leveled in a 3-in. layer by dragging a beam, next sprinkled with a sprinkling wagon, and then puddled by the goats. The puddling was thoroughly done in this way, and the surface left just rough enough for good joint with the next layer.

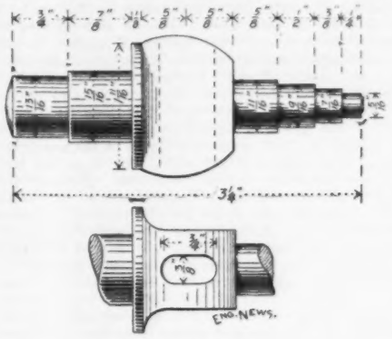
As goats in this arid region are a dry hillside animal, I feared such a radical change in their habits as keeping their feet muddy all day would bring on foot disease. No lameness had appeared among them up to six weeks ago, and I have had no word of any since; it seems likely their hardiness will carry them through.

When the goats were first put to work they tired easily, and were able to stand it but a part of the day; we learned this was upon account of the scanty range upon which they had fed, having to rely mostly upon browsing the juniper brush. A few days, however, of feed on peas and refuse hay brought back their accustomed good spirits. And after their day's work was over, they would butt each other around the corral with the enjoyment characteristic of this singularly precocious animal. J. M. Howells, C. E.

New York, April 18, 1893.

AN INSPECTOR'S HAMMER.

Sir: I inclose a sketch of an inspector's hammer, designed by me. This hammer will fit holes of all the sizes ordinarily used in bridgework, and also indicates



Inspector's Hammer.

thickness of plates. The larger end may be used for finding loose rivets, and on the smaller end is a stamp indicating the individual inspector of iron.

Yours truly,

Cleveland, O., March 31, 1893. James A. Joyce.

THE AREA OF A CIRCULAR SEGMENT.

Sir: Here is a new and accurate formula (at least I have never seen it in print) for finding the area of a circular segment. It is:

$$\frac{R}{2}\ (\text{arc} - \text{sine A})$$

in which A stands for the central angle, R for radius; "arc" for the length of arc to radius one, and "sine" for the numerical expression of the sine-ratio, commonly known as the "natural" sine. This method will, I think, be found to be shorter than the ordinary one of getting two large areas, neither of which is wanted, for the sake of their difference, and is equally accurate.

T. P. Perkins.

Boston, March 29, 1893.

EXPERIMENTS ON HEAT TRANSMISSION THROUGH BOILER TUBE PLATES.

We have noted from time to time in our columns the troubles with leaky tubes in marine boilers, which have for years vexed the souls of the engineers in charge of the British Navy. Briefly told, the facts are that with the introduction of forced draft on the naval vessels an astonishing amount of trouble arose with leaky tubes. After every forced draft run it was necessary to roll the tubes with an expander, and a few experiences of this sort were sufficient to take the life out of the metal. The dangers of this practice were evident, and in several cases more or less serious accidents resulted. An order was finally issued that forced draft should not be used except in an emergency, and there the matter has rested for some time.

Recently it has been announced that by the use of a newly invented ferrule for protecting the ends of the tubes, the troubles from leakage have been overcome. The particulars concerning this ferrule, and an interesting account of the experiments which were carried out by the government engineers, have just been made public in a paper by Mr. A. J. Durston, Chief-Engineer of the British Navy, in a paper read before the Institution of Naval Architects. Questions concerning the transmission of heat through tube plates have been so much disputed over that the results of these official experiments will certainly be studied with much interest. We reprint the paper practically in full as follows:

During the past three years various experiments have been made at Devonport with the view of ascertaining the temperature of tube plates and tubes under certain conditions of working, and their bearing on the leakage of tubes. The first experiments were made in 1890, as follows:

(1) To ascertain the temperature of the hot side of a plate through which heat is passing to boiling water:

For this purpose a circular flanged dish (see Fig. 1) had attached to the bottom eight pieces of fusible solder of different compositions, the melting points ranging from 220° to 250°. The vessel was half filled with water, and placed over a Bunsen gas flame—the temperature of which was about 1,500°—and allowed to remain until the water had been boiling freely some time. It was then found that the alloys whose fusing points ran up to 240° melted, but the next, which would fuse at 243°, only slightly softened. The temperature of that side of the plate was therefore assumed to be about 240°. A layer of grease obtained from the interior of the boilers of a new ship was next spread about 1-32 in. thick over the inside of the bottom of the vessel, and the previous experiment repeated. The temperature of the outer surface of the plate was this time shown by fusible alloys to be about 330°, or a rise of 90°, due to the presence of the layer of grease. The increase of temperature was not so large as was expected, and the experiment on being repeated gave virtually the same results.

(2) To ascertain the temperature at the center of its thickness of a plate resembling a boiler tube plate exposed to a forced blast fire:

A flanged ¾ in. plate was fitted with short lengths of steel boiler tube, as shown in Fig. 2, the center tube being of large size to allow of drilling 3-16 in. holes in the center of the thickness of the plate. In these holes

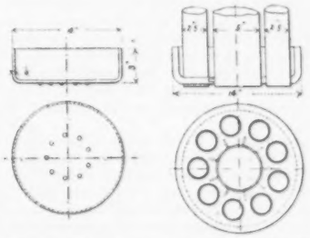


Fig. 1. Plain Vessel Used in Experiment 1.

Fig. 2. Vessel With Tubes Used in Experiment 2.

were placed square pieces of fusible alloys, and the tubes rolled as usual. Water was then put in nearly to the depth of the flange, and the apparatus placed over a forge fire, the blast being used, and the temperature of the fire being about 2,000°F. The experiment was continued for about half an hour, fresh water being supplied to replace that boiled away. It was found that the alloys whose fusing points ran up to 290° had melted, but the next, which would melt at 336°, was unchanged. The temperature of the plate at the center was therefore taken to be between 290° and 336°, a greater temperature even than on the fire side of the plate in the previous experiment when using the Bunsen flame—1,500°.

(3) To determine the temperature of the tube plate at which injurious overheating—i. e., such as to cause leaky tubes—takes place:

For this purpose a small boiler was made, in which there were 24 vertical tubes, 2½ ins. diameter, the tube plate being ⅝ in. thick. Of these tubes eight were brass, seven steel, and nine iron, so that any difference in the behavior of the different materials might be observed, the tubes being as far as possible grouped in threes—one of each—in order to insure their being exposed to the same conditions. A calculated amount of water was put into this boiler, such that, when wholly evaporated, the internal pressure would be 100 lbs.

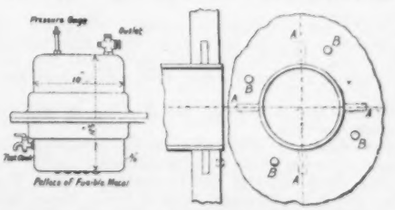


Fig. 3. Vessel Used Experiments 6 and 8.

Fig. 5. Position of Fusible Alloys Around Tube-Ends, Experiments 9 and 10.

per sq. in., means being fitted to prevent this pressure being exceeded by the expansion of the steam gas. The boiler was placed over a forge with the tubes vertical, and the blast put on and continued until the tube plate showed a red heat, equal to about 1,400°F. The pressure of steam inside was at first 100 lbs, but it fell, as the plate overheated. The boiler was then removed from the fire, and allowed to cool. On testing with water all the tubes leaked so badly that no pressure could be obtained. No difference was noticed in the behavior of the brass, steel, or iron tubes. This indicated that raising a tube plate to red heat causes tubes of all these materials to leak very badly.

Next a number of holes were drilled and tapped partly through the plate, and plugs of lead inserted. The previous experiment was repeated, the boiler being removed from the fire as soon as the lead melted, it being assumed that the plate was then at about the same temperature as melted lead, viz., 630°F. The boiler was afterward tested by water pressure to 200 lbs. per sq. in., practically without any leaks. The tapped holes were next filled with zinc plugs, and the

experiment repeated, the steam pressure being 80 lbs. per sq. in. Two of the brass tubes split during this experiment, and on testing the boiler after replacing them by new it was found necessary to roll two other brass tubes, after which the boiler was practically tight up to the test pressure of 200 lbs., the iron tubes being without a weep, and a few of the brass and steel tubes leaking very slightly. It is, therefore, assumed that a tube plate to be overheated sufficiently to make the tube joints leak to an appreciable extent must be raised at least to the temperature of melting zinc, viz., 750°F.

(4) To ascertain the loss of efficiency of the heating surface of tubes in a boiler, due to a thin coating of grease deposit:

A tube taken from a boiler of a new ship was cut into lengths, and tried in the apparatus, which consisted of a rectangular iron vessel to hold the water, with holes and stuffing boxes for the piece of boiler tube under test, the heat being supplied by a horizontal Bunsen burner. The results of the experiments showed that the thin coating of grease deposited on these tubes during the ship's trials caused a loss of efficiency as heating surface, as compared with a perfectly clean tube, of from 8% to 15%, the mean of many experiments giving 11%. During 1892 some of these experiments have been repeated on an extended scale, as follows:

(5) Temperature of plates when boiling water in an open vessel under various conditions:

A vessel similiar to that used in Experiment 1, but larger, being a flanged dish 2 ft. in diameter, 2½ ins. deep, and ¼ in. thick, was used, and a constant supply of water was maintained. The vessel was placed over a forge fire instead of over a Bunsen burner. With a moderate blast the temperature of the hot side of the plate was as before found to be 240° when boiling fresh water. More blast was then applied, and the temperature of the plate went up to 280°F. This experiment was extended by repeating it with various foreign substances in the water, with the results shown in the table:—

	Temperature. Hot side of plate.	Fire.
Clean fresh water	280°	2,000°
*Mineral oil gradually added up to 5%	310°	2,300°
Fresh water with 2½% paraffin	330°	2,400°
Fresh water with 2½% methylated spirits	300°	2,900°
**A greasy deposit $\frac{1}{8}$ inch thick on plate.	above 550°	2,500°

(6) Temperature of plates when boiling water under various conditions at a higher temperature than 212°F:

The higher temperature was obtained by using a closed vessel, shown in Fig. 3, and boiling the water at pressures above atmospheric. The following results were obtained:

	Temperature. Hot side of plate.	Water.	Difference.
a) Using clear water and surfaces. Over Bunsen burner	436°	363°	67°
Over blast forge (full blast)	430°	344.5°	85 5
(b) Bottom of vessel coated with grease (forge fire).			
Grease $\frac{1}{8}$ in. thick	510°	359°	151°
Using drier grease	550°	351°	199°
Ditto, and spread on sides as well as bottom	617°	86°	557°

In the last experiment in the table the grease was spread 1½ in. up the sides of the vessel from the bottom, being then 1 in. below the water level. The temperature of 617° was reached three minutes after turning on the blast.

(7) Experiments showing the behavior of tubes of various materials.

The experiments described in the last paragraph were repeated several times with an apparatus similar, but having tubes fitted in the heated plates. The tube plate was ⅝ in. thick, and tubes of brass, copper, iron and mild steel were tested simultaneously. It is not necessary to give particulars of these experiments, as they were repeated on a larger and more reliable scale in experiments 9 and 10; but it is worthy of remark that on all occasions some brass and copper tubes leaked even when the plate was below the temperature of melting lead, (617°F), showing that these materials did not stand so well as iron or steel, while between the latter materials—Staffordshire as well as Lowmoor iron tubes being used—there appeared to be practically no difference.

(8) Experiments to determine whether at high pressures of steam there is any marked addition to the excess of temperature of the hot side of the plate over that of the boiling water:

These were carried out with the closed vessel shown in Fig 3. A large number of results were obtained, the details of which showed that there is no marked addition to the excess of temperatures at the higher pressures.

(9) Experiments on the temperature of the center of the thickness of a tube plate, with an experimental boiler working with closed ashpits and moderate air pressure:

Fig. 4 shows this experimental boiler with its brick furnace. The tube plates are bolted to the shell, so as to admit of being easily removed and replaced by others. As first fitted, the draft was supplied through a closed ashpit, and under these conditions a two hours' trial was made, of which particulars are given below. Five of the tube holes—Nos. 10, 14, 28, 45 and 50—had each four pieces of fusible alloy ⅝ in. long let into the plate at the middle of its thickness, as shown at A, A, A, A, Fig. 5. The condition of these at the conclusion of the trial is given in the table. The maximum temperature obtained in the combustion chamber was 3,100°, and the maximum temperature of the steam 366°. From the table it will be seen that, of the pieces of fusible alloys placed in the tube plate, all the six whose melting points run from 435° to 490° had fused completely. The ten ranging from 540° upward remained unchanged. Of the intermediate ones, those having melting points of 500° and 510° remained unchanged, while two others with melting points of 520° and 530° were fused just at the ends near the tubes. It would appear, therefore, that the temperature of the

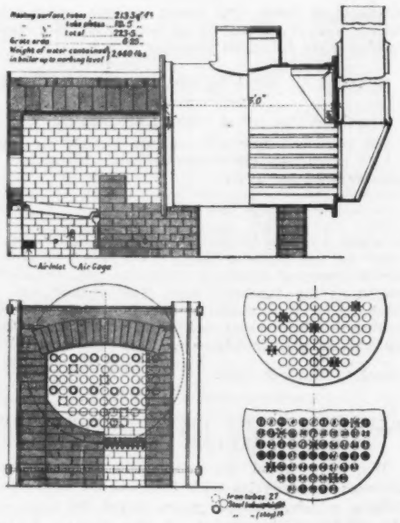


Fig. 4. Marine Boiler used in Experiments 9 to 12.

plate at the middle of its thickness did not rise to 540°, but at some of the tube joints it rose to 530°.

Data of two hours' run.	Mean.	Maximum.
Steam pressure	143 lbs.	150 lbs.
*Air pressure in closed ashpit	0.3 in.	0.5 in.
**Temperature combustion chamber	2,850° F.	3,100° F.
Temperature in tubes (middle of length)	1,550° F.	1,800° F.
Temperature in smokebox	1,400° F.	1,600° F.
Coal used per hour	188 lbs.	.....
Coal used per sq. ft. of grate	30 lbs.	.....
Water evaporated per hour	1,039 lbs.	.....
Water evaporated per hour per sq. ft. of tube and tube plate surface.	4.62 lbs.	.....

Condition of fusible alloys in tube plate.

Tube 50: Melting point of alloy	435°	450°	465°	470°
Condition	All fused completely.			
Tube 45: Melting point of alloy	480°	490°	500°	510°
Condition	All fused except the 500° piece.			
Tube 10: Melting point of alloy	510°	520°	530°	540°
Condition	Not fused.	Fused at end next tube.		Not fused.
Tube 28: Melting point of alloy	550°	617°	680°	773°
Condition	None of them fused.			

Tube 14: Same alloys and same results as tube 28.

(10) Further experiments to ascertain the temperature of fire side and middle of thickness of tube-plate in experimental boiler with forced draft and closed stokeholds:

Due to the difficulty in stoking the boiler arranged as previously described, the flames blowing out into the stokehold unless the draft was shut off the ashpit each time of firing, the boiler was inclosed in an air-tight stokehold, and the draft supplied by a fan and engine of increased dimensions in order to obtain a higher rate of combustion. Under these altered conditions the trials were continued, and, in addition to the fusible alloys let into the middle of the plate, four pieces 5-32 in. long and 3-16 in. diameter were fitted into the face of the plate, around each of the tubes mentioned, as shown at B, B, B, B, Fig. 5. These pellets projected 1-32 in. beyond the plate.

The following table shows the observations made in five trials with this boiler:

Number of Trial.	1.	2.	3.	4.
Duration of trial, hrs.	5	5	5	3½
Pressure of steam, lbs.	145	142	140	144
Air pres. in stokehold ..... ins.	3	3 to 3½	3	2.9
Coal used ..... lbs.	2,800	3,188	2,632	Not accurately taken
Water evaporated, lbs.	11,125	14,775	13,148	10,276
Coal per sq. ft. grate per hr ..... lbs.	90	102	84.2	
Water evap. per sq. ft. tube and tube-plate surf. per hr., lbs.	12.64	13 22	11.76	11.90
Temp. in combustion chamber	2,755°	2,500°	3,100°	3,200°
Mineral oil used..lbs.	....	....	9	5
Oil used in percentage of feed	...	....	.07	.05

* Boiler not cleaned out from previous trial.

On the first trial (five hours with 3 ins. air pressure, using clean feed water) 16 of the pellets in the face of the plate were made with melting points from 480° to 690°, and the remaining 4 were of antimony (melting point 1,060°). All were melted except the 4 antimony.

On the second trial (five hours with 3 ins. air pressure during the first two hours, and 3½ ins. during the next three, using clean feed water) the pellets placed in the face of the plate around each of the five tubes were: One of antimony (1,060°), two of zinc (750°), and one of alloy melting at 690°. Of these the 5 antimony and 3 of the zinc (at tubes 14, 45 and 50) remained intact; all the rest melted.

On the third trial, which was of five hours' duration, with 3 ins. air pressure, with the pellets arranged as on the preceding trial, a total quantity of 9 lbs. of oil was admitted to the boiler mixed with the feed. The five antimony and one (at tube 45) out of the ten zinc plugs remained intact; all the rest melted. As this was the last trial at which the tubes remained tight the temperature of the plate should be noted for comparison with the next trial when the tubes gave out. Since all the zinc pellets melted (except one low down at the edge of the tubeplate), the temperature of the tubeplate must have been above that of melting zinc (750°) and below that of antimony (1,060°).

On the fourth trial, which was a continuation of the third, an additional 5 lbs. of oil was admitted with the feed water. During this trial the tubes gave out when cleaning fires after 3 5-6 hours' run. The pellets in the tubeplate were arranged as before, and melted as follows: Around tubes 10, 14, and 28 (hottest part of the plate) all the zinc and alloys melted; the antimony partly melted in Nos. 14 and 28, but remained intact in No. 10. Around tubes 45 and 49 the antimony and zinc remained intact. This shows that the plate was about the temperature of 1,060°, at all events during the latter part of this trial, and it is presumed that the tubes then gave out; whereas, from the results of the third trial, the tubes remained quite tight up to and above the temperature of melting zinc, 750°.

The five tubes were now drawn, and the fusible alloys which had been let into the plate at the center of its thickness were examined. They were made with melting points ranging from 480° to that of zinc, 750°. All were found to be melted, except the zinc, which was at tubes 14 and 28.

Comparing the highest temperature shown at the face and center of the plate around the tubes most exposed to heat, the temperatures are as follows:

Temperature at face of plate.	Temperature at middle of plate.
Antimony partly melted, i. e., 1060° F.	680° alloy melted; zinc not melted, i. e., between 680° and 750° F.

(11). Experiments as to behavior of Lowmoor iron versus steel tubes, as regards leakage in experimental boiler:

The series of trials just reported were also made use of to determine the relative merits of steel and iron tubes as regards leakage. The particulars of the trials have been given in the table above, and the arrangement of the tubes is shown in Fig. 4. The results were as follows:

First trial of five hours' duration with 3-in. air pressure.—No leakage of tubes occurred at this trial.

Second trial of five hours' duration with 3-in. air pressure for first two hours, and 3½ ins. for next three hours.—At the conclusion of this trial the fan was kept going for some time after drawing the fire, but no leakage of tubes occurred. Attention is called to this fact, as great stress is frequently laid on the action of cold currents of air in producing leaky tubes.

Third trial of five hours' duration with 3-in. air pressure, a certain proportion of mineral oil being mixed with the feed-water.—On this trial no leakage of the tubes occurred.

The fourth trial was proposed to be an eight hours' continuation of the last, using oil in the proportion shown on the table.—At this trial leakage of tubes occurred under the following circumstances:—Just before the end of the fourth hour the fire was being burned down to clean it, in order to be able to work for eight hours, the air pressure being gradually reduced. Ten minutes after beginning to burn down, and

*Genuine American distilled oil, with the paraffin scale extracted, so that the oil will remain fluid at 32°F, with a minimum density of .91, and a minimum flash point of 400°.

**Other experiments showed that this temperature varies greatly, and depends chiefly on the nature and thickness of the deposit.

*The highest air pressure with the fan then available.

**Temperatures measured by a Le Chatelier pyrometer.

with the air pressure at 1 in., the tubes gave out, and began to leak badly. On examination of the boiler, it was seen that six Lowmoor iron tubes and one steel tube leaked badly; three Lowmoor tubes and nine steel tubes leaked slightly. On applying water pressure it was found that at 60 lbs. all the tubes in the boiler leaked, more or less, except No. 34, and the tubes in the two bottom rows, which were probably protected by ashes, etc., during the trial; but the three Lowmoor tubes, Nos. 14, 16 and 18, were leaking most. The results of these trials, therefore, appear to show that Lowmoor iron tubes are at least not superior to steel ones; and, as from experience we know that the latter will stand more rolling than the ordinary iron tube of commerce, it justifies our preference for steel tubes.

12.) Results obtained with grease in boilers:

As bearing on the important point of the presence of grease in boilers, it may here be stated that in one of the yard boilers at Portsmouth, the furnace crown came down shortly after concluding some experiments in using greasy water. In a similar boiler at Devonport the Adamson joint of the furnace gave out after similar treatment. These boilers were ordinarily worked at about 60 lbs. pressure, and used only fresh water from the yard mains, and experienced no serious defect till the introduction of grease experimentally. This is again borne out by repeated examples in navy boilers of all types of the deleterious effect of the presence of grease in them. Referring back to the former part of this paper, experiments 4 and 5 also show how very great is the effect of grease on the water side of the plate-heating surface. These are also confirmed by the trials with the experimental boiler, which, although subjected to the high-pressure of about 3,000° in the combustion chamber, and 1,600° in the smoke-box, and further subjected to hard treatment by admission of cold air through the tubes after drawing the fire at the conclusion of the second trial, did not leak till grease was used in it.

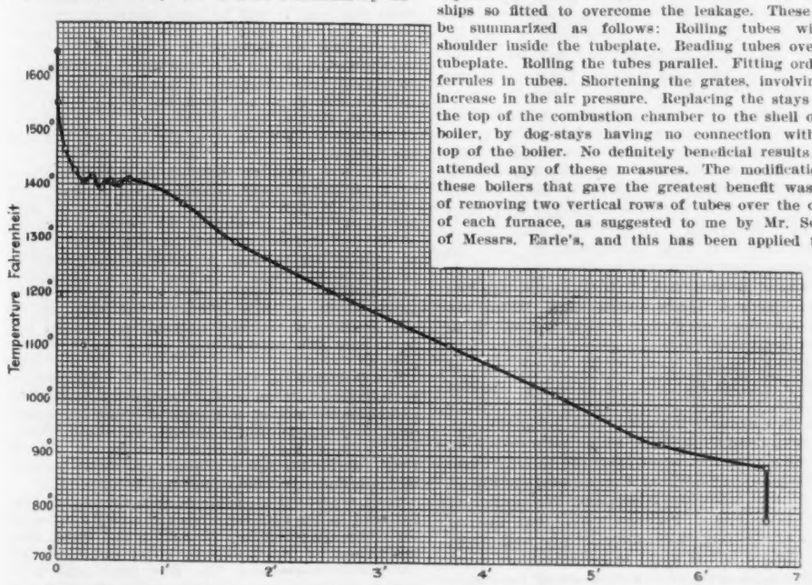


FIG. 6. FALL OF TEMPERATURE IN THE TUBES OF A MARINE BOILER FROM COMBUSTION CHAMBER TO SMOKE BOX.

(13.) Experiments on the temperature at various parts of the tubes of an ordinary marine boiler:

The following experiments were made to ascertain the fall of temperature of the products of combustion in passing through the tubes of an ordinary marine boiler used in Keyham Yard. This boiler had two furnaces and 166 return tubes 2¾ ins. external diameter, and 6 ft. 8 ins. long, outside to outside of tube plates. The temperatures were taken by a Le Chatelier thermo-electric pyrometer, the junction of which was passed through the smoke-box and down the center of the tubes. Tubes in a vertical row nearly over the center of one of the furnaces were taken for the experiment. The temperature was recorded at each foot length until near the combustion chamber, where it was taken at every inch. The boiler was being worked at its normal capacity, the consumption of coal being about 17 lbs. per sq. ft. of grate. The following are the mean results of eight sets of records:

Temperature in combustion chamber, 1,644°; just inside tube, 1,550°, and at various distances from combustion chamber, as follows:

1 in	2 ins.	3 ins.	4 ins.	5 ins	6 ins.	7 ins.	8 ins.
1,466°	1,426°	1,405	1.412°	1,398°	1,405°	1,400°	1,410°
1 ft. 2 ins.	1 ft. 8 ins.	2 ft. 8 ins.	3 ft. 8 ins.	4 ft. 8 ins.			
1,368°	1,295°	1.198°	1,106°	1,015°			
5 ft. 8 ins.	6 ft. 8 ins.	In smoke box.					
9,260°	887°	782°					

It will be seen that about 2-11 of the total fall of temperature takes place in the first 2 ins., after which the fall is fairly evenly distributed throughout the length of the tube.

The above shows that even beyond 6 ft. in length there is an appreciable transfer of heat, but a further experiment will be made by shortening these tubes by 1 ft. and lengthening the combustion chambers by the same amount, and making comparative trials as compared with the boiler as now arranged.

(We have plotted the above results in Fig. 6. It will be noticed that the variations near the hot end of the tube are such as to make the accuracy of the tests rather doubtful. As for Mr. Durston's statement that "the fall in temperature is fairly evenly distributed throughout the length of the tube" a large number of experiments have shown that the rate of fall in temperature decreases quite rapidly, as the gases move from the furnace toward the smokebox. The extreme left hand portion of the curve in Fig. 6 agrees substantially with the results of other experiments; but the main part of the curve should be much more concave, to agree with them.—Ed.)

The above concludes what may be termed the experiments made on a small scale, and an account will now be given of some experiments on a larger scale on shipboard, with the object of avoiding leakage of boiler tubes.

It is a matter of common knowledge that the Admiralty has experienced considerable trouble with leakages of tubes in the double-ended common combustion-chamber boilers and those of the locomotive type. Of the former there are three kinds, distinguished by having either two, three or four furnaces at each end. As regards the two-furnace type, various expedients have been tried in one or other of the ships so fitted to overcome the leakage. These may be summarized as follows: Rolling tubes with a shoulder inside the tubeplate. Beading tubes over the tubeplate. Rolling the tubes parallel. Fitting ordinary ferrules in tubes. Shortening the grates, involving an increase in the air pressure. Replacing the stays from the top of the combustion chamber to the shell of the boiler, by dog-stays having no connection with the top of the boiler. No definitely beneficial results have attended any of these measures. The modification in these boilers that gave the greatest benefit was that of removing two vertical rows of tubes over the center of each furnace, as suggested to me by Mr. Seaton, of Messrs. Earle's, and this has been applied to all the boilers of that type. It has also been applied to those having three and four furnaces at each end, but the results in these cases were not nearly so satisfactory. In these boilers the expedients of shortening the grates and easing the stays immediately above and below the tubes, so as to allow a slight movement of the tube-plates with the expansion of the tubes, have also been tried, with no permanent benefit.

Continued experience with the "Thunderer" and "Vulcan"—vessels having this double-ended common combustion-chamber boiler with three furnaces at each end—was so unsatisfactory, both on trials and on actual service afloat in the former ship, that the re-boilering of these ships, as well as the "Devastation," was provided for in the navy estimates for the current financial year. In all these boilers the combustion chamber was divided by brick walls into a separate combustion chamber to each furnace, or to each two adjacent furnaces in the eight furnace boilers. In the "Thunderer" and "Devastation," from the arrangement of the nests of tubes, it was only possible to divide the combustion chamber into two parts, one to each end of the boiler.

Concurrently with the efforts that were being made to overcome the leaky tube troubles by improving the circulation, experimental trials were being conducted in the locomotive boilers of the torpedo gunboat class—(1). By plastering the tubeplate with a non-conducting composition, thus protecting it on the fire side; and (2) by ferruling the tubes with fireclay cap ferrules, the caps of which afforded protection to the tube ends and the larger part of the tubeplate. The object of these experiments was not to demonstrate the effectiveness of the materials used, but to show whether the leakages of boiler tubes were not due to the overheating of the tubeplate and ends. This was established, for as long as, in the first case, the cement adhered, and in the second case the ferrules lasted, leakages did not occur. They were, however, both liable to rapid destruction, and could not be relied on as a permanent protection. Numerous devices having a similar object were from time to time suggested, but all had practical difficulties preventing their adoption.

Among the first of the practical suggestions made for ferruling the tube ends was that patented by

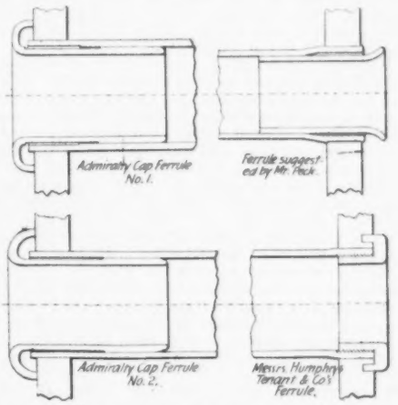


Fig. 7. Various Forms of Ferrules for Protecting Tube Ends.

Messrs. Humphrys, Tennant & Co., and illustrated in Fig. 7. It will be seen that this ferrule is screwed into the tube at the firebox end, and that the cap fits into an annular recess cut in the tubeplate. The principle of this ferrule is that when a contraction in diameter takes place, due to variations of temperature, the outer part of the ferrule tends to tighten upon the concentric portion of the tubeplate. Further, as the ferrule is screwed into the tube, it has the advantage of the holding power afforded by the rolling of the tube into the cooler smokebox tubeplate. It will also be seen that from its construction it provides a large amount of jointing surface, and an intricate passage to prevent the escape of water. On the other hand it has the disadvantage that ferrules cannot be withdrawn for cleaning and repairs, but must be cut out, and it is somewhat costly in fitting.

Messrs. Humphrys' proposal to fit these ferrules in the two after six-furnace common-combustion chamber boilers of the "Medea" for trial was approved. For these trials iron tubes were fitted in the starboard boiler, and steel tubes to the port boiler. The modifications that had already been made in the furnaces, combustion chambers, and tubes were allowed to stand for these trials. They consisted in shortening the grates of the middle furnaces by the removal of the back tier of bars, dividing the common combustion chamber by brick walls to form a separate combustion chamber to each furnace, and the removal of vertical rows of tubes over the furnaces. An eight hours' trial of both boilers was made at natural draft power which was satisfactorily obtained with a mean air pressure of 1.26 ins. The examination of the boilers showed that about 70 tubes in all had leaked very slightly. The ferrules had practically not scaled by oxidation. The leaks were so trivial that nothing was done to them before proceeding with the four hours' forced draft trials, which were successfully made with each boiler singly, 1,895 and 2,039 I. HP. being obtained with the starboard and port boilers, respectively, with 2.85 ins. and 2.9 ins. of air pressure, as against 2,250 I. HP., the specified power per boiler. On examination, slight unimportant leakage of the tubes was observed, and the ferrules were practically free from oxide scale. Subsequently, the eight hours' natural draft trial was repeated, 3,013 I. HP. being obtained with a mean air pressure of 1.05 ins. On examination, a few tubes were found to be leaking slightly under the water pressure, but not sufficiently to necessitate further rolling. No difference was observed in the behavior of the iron and steel tubes.

Shortly after the above ferrule was suggested, Mr. Peck, of Messrs. Yarrow's firm, sent me a letter, proposing a ferrule of the shape shown in Fig. 7. The points claimed for this in his own words were as follow:

Something in this direction has, I am aware, been already proposed; but in this proposal you will see that the tube ferrule or protector does not touch the tube where it is fixed to the tube-plate, but is in contact with the tube only at a part where all its heat may be readily absorbed. The space between the pro-

tector and the tube is rather exaggerated in the sketch, but it is only intended to be that due to expanding the ordinary straight tube.

It will be seen from this that Mr. Peck considered the space produced by the rolling of the tube in the tube-plate would be effective in producing the desired result, and it was not proposed to protect the tube-plate by any flanging of the ferrule. The idea of a space formed between the ferrule and the tube at its junction with the firebox tube-plate was recognized as an important point, and a few hours subsequently Mr. Oram, Engineer Inspector, proposed to me a cap ferrule as one which would provide an effective air space between the ferrule and the tube at, and for a short distance beyond, its junction with the tube-plate, and by its cap also protect the greater portion of the firebox tube-plate from direct contact with the products of combustion, and proportionately reduce the formation of steam on the water side of the tube-plate.

Experience has resulted in the shape of ferrule shown in Fig. 7, but it will be seen that the effective points remain the same. In order to make a practical test, these cap ferrules were fitted in the "Barracouta's" boilers, which were of the double-ended common combustion-chamber type. The port boiler was fitted with wrought steel ferrules, and the starboard boiler partly with the same and partly with malleable cast iron ones. On an eight hours' trial of the port boiler at natural draft 978 I. HP. was developed, with a mean air pressure of 1.07 ins., as against 950 I. HP. specified, the trial being in all respects satisfactory. It was found that not a single tube had leaked; some of the ferrules were loose, and could be turned round by hand, but none of them could be swept out by a brush. The faces of the ferrules, and in a few cases the insides, showed signs of burning and scaling. The loose ferrules were tightened by light rolling with expanders, and on a four hours' trial of the same boiler at forced draft 1,450 I. HP. was developed with a mean air pressure of 2.41 ins. Slight priming occurred, which prevented the development of the full power of 1,500 I. HP. This trial was also satisfactory, examination showing that no tubes had leaked. The scaling of the ferrules seemed to be no worse, the first formation appearing in a measure to protect the ferrules from further burning. Next, an eight hours' natural draft trial was made of both boilers; 1,912 I. HP. was satisfactorily obtained with a mean air pressure of .69 in., the specified power being 1,900 I. HP. All the tubes in the port boiler were tight, but one tube in the starboard boiler showed slight indications of having leaked.

The scaling of the ferrules—more especially the wrought steel ones in the port boilers—after this trial was observed to have increased; the first formations had in many cases curled up and broken off, leaving fresh surfaces exposed to the fire and consequently new scalings had formed. A few ferrules were loose.

A forced draft trial was next made with the starboard boiler. Difficulties arose with the fans, and it was decided to stop the trial after three hours; 1,416 I. HP. was obtained with a mean air pressure of 2.3 in. Not a single tube leaked.

Subsequently an eight hours' natural draft trial with both boilers was repeated, 1,932 I. HP. being developed with a mean air pressure of .77 in. Examination of the boilers showed that no tubes had leaked, a few ferrules were loose, and further breaking off of the scale and deeper burning of the ferrules had occurred. It was noticed that the scaling of the malleable cast iron ferrules appeared to be much less than that of the wrought steel.

At the conclusion of these trials the full water pressure test of 245 lbs. was applied to both boilers, and not a single tube leaked.

After these satisfactory trials the ferrules were fitted to the six-furnace double-ended common combustion-chamber boilers of H. M. S. "Thunderer," which had given great trouble from leaky tubes at all powers down to less than one-third natural draft. On an eight hours' natural draft trial after the cap ferrules were fitted, the indicated horse-power obtained was 5,900, with an average air pressure of 1.2 in., the specified power being 5,500. Examination showed a few throat seams, rivets and stay nuts to be leaking, but not one tube.

Next, a four hours' forced draft trial was carried out, the results being 7,066 I. HP., with an air pressure of 1.96 in., that specified being 7,000. Examination showed only ten tubes leaking slightly out of about 3,000. With a view to testing the durability of the cap ferrules, the "Thunderer" was directed to proceed to Madeira and back at four-fifths of her specified natural draft power, i. e., 4,400 I. HP., and sailed for that purpose on the morning of July 16, at 6 a. m., arriving at Funchal at 1:30 p. m. on the 20th. Leaving again at 9.30 a. m. on the 23rd, the power on entering the bay was increased to 4,700 I. HP., and maintained till Portsmouth was reached at 3:45 p. m. on the 27th. The average speed out and home was 12.8 knots. Examination of the boilers showed one ferrule to be missing, and its corresponding tube leaking; also one adjacent tube showed signs of having leaked slightly. Several ferrules had become loose, but could not be removed by hand. The ferrules were thickly furred in the manner frequently observed in torpedo boat locomotive boilers, and about 30 out of 3,000 were worn out.

During the past week, the "Vulcan," after having the vertical rows of tubes—those which had been removed to improve the circulation—replaced, and the tubes cap ferruled, has gone through a satisfactory four hours' forced draft trial, the indicated horse-power being 12,032, as compared with 12,000 I. HP. specified, the mean air pressure being 1.8 in. These cap ferrules have been fitted to several other ships having various types of boilers, with satisfactory results, and requests for them are being made by ships of the fleet with the view of protecting the tube-plates and ends from overheating produced by accumulation of grease or scale in the boilers, and they will be probably fitted to most vessels. In respect of protecting the tube-plates and ends from overheating, whether by want of circulation, excessive temperature in the combustion chamber, or from the presence of grease or solid matter, it is submitted these cap ferrules have fully answered their intended purpose.

SALOON CARS IN CAPE COLONY.

While English railway officials, both in England and the colonies, have certain prejudices against American material and methods, due to lack of familiarity with or understanding of the principles upon which the methods of construction and management are based, they have sometimes an unpleasant habit of applying the term "American" in cases where it is by no means rightly applicable, and where it generally indicates mere roughness and cheapness. As stated in our issue of Feb. 16, English locomotive builders deny any claims for superiority in American engines, but nevertheless offer to build "American" types of engines, for colonial railways, although the engines are generally of purely English design, with such additions as pilots, headlights and more or less complete cabs to give them a somewhat American appearance. It is very doubtful if the builders of these engines are at all familiar with the principles and practice of American locomotive construction. An example of this misapplication of the word comes from South Africa, where, on the Cape Government Railways, 3 ft. 6 ins. gage, are run some rough and ready saloon cars which are styled American or Pullman cars, but which in their construction and equipment appear very strongly to resemble some of the saloon cars of English railways, of which we have had personal experience, a specially aggravating circumstance experienced in more than one case being the provision of a lavatory without water, soap or towels, and with a very foul smell from the closet. From an article in the "Railway Press," of London, we abstract the following interesting description of the South African "Pullman cars," but the remarks as to heating do not appear to be well taken, as the climate is too warm to necessitate such arrangements, in spite of the coolness of the mornings.

The American who kicks at his railway accomodation should go abroad, and especially to Africa. He should take a journey on any of the different routes, and there are only three in South Africa at present. He cannot go amiss on any of them for an experience, and when he is permitted by a relenting fate to meet once more a train of railway cars in his native land, he will feel like doffing his hat to it, and his complaints will be forever silenced. Before arriving at Cape Town inquiries are naturally made about the trains running to the interior, the accommodation they afford, etc., and with much parade the information is given that Africa now has "Pullman palace cars" running on its lines. The contemplation of doing the journey in a Pullman car is as satisfactory as anything can be, and one is hardly prepared for disappointment. A special train leaves Cape Town every Thursday on arrival of the English mails, and on this train only are the "Pullmans" run.

Most Americans who have knocked about their own country will have pretty elaborate expectations concerning a "special fast mail train" announced in big letters, which has only sleeping cars attached, and carries none but first class passengers, because their ideas are drawn from the "limited" trains run on the best lines at home, which are the acme of perfection in their way; but their big ideas suffer a most lamentable collapse when they take their first ride on an African Pullman. These trains also carry what is termed in this country a "dining saloon," a car one-half of which is made into a kitchen, in which to cook meals to be served on the train. The other half of this car consists of "sleeping accommodation." These are nothing more or less than the ordinary English narrow-gage car, with a narrow passage running through at just one side of the center, having an ordinary double-width section on one side of the passage, and a half-width section on the other side. The seats in each of these sections face each other, as they do in the regular Pullman. At the edge of the aisle, and in the center of the space, or leg room, between the seats, is a fixed standard, which serves to support the outer end of a table when the table is required for use, and it serves as an infernal nuisance all the remainder of the time.

The cushions are of leather, and quite hard. There are no fires and no way to heat the cars. There is no ornamentation or overhead ventilation. The windows are arranged like cab windows, dropping down into sockets, and raised by means of a broad strap, and are only single windows. The sockets serve a double purpose, for in addition to taking in the windows they let the air into the cars. This is all right enough in warm weather, but it is not agreeable in cold weather by a large majority. Another advantage of these loose windows is that they beat a sort of rat-tat to the otherwise monotonous rattle of the train, and this has a tendency to prevent one from falling asleep and so missing many interesting views.

When the guard or conductor on the car is asked to "make up" the berth, it is done in the following manner: The lower berth is pulled out, and the cushions laid upon it in the regulation fashion; the upper berth consists of a rail, each end of which slips into a slot just 26 ins. from the side of the car, and to this rail and the side of the car is fastened a piece of canvas just 26 ins. wide. This is pulled out, and along this canvas, cut to fit, is laid a strip of heavy moquette carpet, and there you are. It will be some future generation in Africa who will crack the stale jokes about pulling the "sleeping car" pillows out of their ears, for passengers are all obliged to furnish their own bedding or go without. One advantage of this arrangement is that they are entirely relieved from any anxiety as to who may have slept in the bed previously or what traces of his presence a predecessor may have left behind in the bedclothes.

Imagine an American passenger on a first-class train being invited to array himself in his overcoat, and, wrapped in rugs, to squeeze himself into a 26-in berth, and there, pressed in the persistent embrace of side rail and car, to pass the night with all sorts of zephyrs singing songs of influenza and pneumonia in his ears the whole night long, and having nothing as a compensation except, when the passengers in the lower berths complain of the bruises made by the uneven edges of the hard cushions, the thought that he at least does not have that evil of which to complain.

The lavatories in these cars are in compartments large enough to accommodate one person comfortably, and along one side of each runs an unpainted wooden shelf, in which is sunk a metallic wash-basin. There is no soap, no glass, no drinking water, and a public towel. As for the accommodations other than lavatory, they are there, just there, and that is all.

Meals are served at each seat from the kitchen compartment in the rear car. When the meal hours occur the tables are placed in each section, and spread after the manner of Mr. Pullman's buffet cars, and then the parade commences. The first thing done is to open every car door in the train except the front door on the first car and the rear door on the last car. The meal orders having previously been given from a menu circulated for the purpose, a long procession of waiters and guards, including the conductor, commences to travel back and forth, serving meals. No trays are employed, and through the train, across the open platforms, in the dust and cinders, the open dishes are carried. One good, live American descendant of the dusky tribes which throng this continent will serve more food than all the crew of helpers and waiters on one of these trains.

At meal time there seems to be no best part of the train, the meals in the rear car come hot, but the door is open, and there is nothing for it but to sit and eat with the cold blast pouring in, depositing its burden of dust and cinders all over the food, and sending the temperature of the car away down into the wheels. Those in the forward car need not freeze; but their food comes cold and full of cinders. All through meals, men are running back and forth, replenishing dishes, and the doors must stand wide open.

The nights and mornings are nearly always cold on the high veldts of the interior. There is no way of heating the cars. Passengers must wash in icy water, served in a cold lavatory, and then go and sit in a howling draft to get breakfast. All this is on a special fast mail train. One can have the door shut and keep warm at the sacrifice of meals, or have meals and freeze.

Some of the cars, and these are the best, taking everything into consideration, are divided into compartments opening into a narrow passage, which runs along one entire side of the car. Each compartment

will accommodate four people, but is usually occupied by two. There is a long stationary table between the seats in every compartment. When it was suggested to an official of the road, who happened to be on the train, that temporary tables like those used by the Pullman company would be much more convenient, he replied: "Bless your soul, man, you are not in America, you know." He was assured that the entire experience of an African railway journey kept that fact so continually before one that this suggestion was unnecessary.

And so the passengers sit for 18 hours a day right at the table at which their meals are served. It is a sort of perpetual meal, or, rather, waiting for meals, from beginning to the end of the journey, and the same cars have the same sliding doors and windows, no overhead ventilation, no fires. By the shades of your departed ancestors, Mr. Pullman, and for the credit of your time-honored comforts, you should resent this hideous sarcasm upon your name. Of course, at its worst, this is infinitely better than the old way of traveling by wagon, and, as all things are judged by comparison, the Africander thinks this sort of traveling the perfection of luxury.

If the extra-fare trains, run as a special feature only once a week, are like this, what must be the regular trains, where there are no lavatories, no ladies' rooms, no place to lie down, no meals served on train? Curiosity on this point is curbed by an amount of cowardice which bars an actual physical test. And these are the best fast trains running between Cape Town, the seaport, and Johannesburg, the latter the biggest mining town in the world, with a population of nearly 40,000 souls, and an output of more than 100,000 ounces of gold per month. The distance between these points is less than one thousand miles, and these "fast trains" consume 60 hours on the journey.

A part of the baggage is carried on top of the baggage-car, under a canvas cover; and it is a positive fact that the train was held at several stations while the covers were removed, a trunk or bag taken down, out of which passengers would take some clean clothes, and then they were replaced, the canvas strapped down, and the train would move on.

It is necessary to go out upon the open platform in order to enter the men's private toilet-rooms. The women's retiring-room is quite commodious, and is entered from the interior of the car. The chief merit possessed by these cars seems to lie in the fact that, contrary to nearly everything else in the unappreciative world, in them the women seem to have the best of it. The doors in the cars also slide, but differ from the sliding windows and sliding tariff, in that the former of these slide down, and the latter generally slides up, while the doors slide sideways, and about all these doors really can be depended upon to successfully accomplish is to bar the ingress and egress of individuals and to obstruct the view.

A road in the United States that gave such accommodation to its patrons as is given here would not last long enough to get a hot-box.

THE WHITE MAGAZINE RIFLE.

The magazine rifle invented by Lieutenant White, of the United States Marine Corps, and lately tested by the Army Board of Experts at Springfield, Mass., failed in the trial from a defect of manufacture. The principle upon which the gun is constructed has been highly praised, however, and it may still enter into the present test after repair. It is worthy of description in any event.

As will be seen by the cut given, its parts are exceedingly simple and few in number, and it is thus cheaper to manufacture and less liable to derangement, and it also weighs less than the Krag-Jorgensen rifle illustrated in our issue of Oct. 6, 1892. Only three motions are required to load and fire the White gun, while the Krag-Jorgensen requires eight motions. The White gun can be loaded and fired either rapidly or slowly and continuously, and loaded in any position and at any gait.

The bolt movement is claimed to be the simplest in the world. One of the best descriptions we have yet seen of the manipulation of this rifle is that in the "Army and Navy Register" of March 25, which is as follows:

The improvements claimed for the White gun are principally in the bolt and magazine. The bolt requires but two motions of the hand, back and forward, making it convenient to fire rapidly without removing the piece from the shoulder. It consists of the bolt proper, the bolt side, on which is the handle and the lock. The lock is a Sharp (Krupp) block, the application of which to a bolt gun has long been desired by small-arms men. It moves transversely in the head of the block, engaging the receiver at both ends to lock the bolt, and is shifted by means of a projecting pin engaging a cam slot in the bolt slide. When the slide is drawn back it moves to the left to unlock, and as soon as disengaged the whole bolt moves to the rear to open the breech. A movement in the opposite direction closes the breech and drops the bolt.

When unlocked a projection on the firing pin engages a recess on the block to hold it over. At the same time the firing pin is retracted, and at no time can it strike the cartridge until the bolt is locked, a second recess in the block for the firing pin allowing it to do so then. The block is so shaped as to exert a powerful extracting action on shifting to start the cartridge shell, the force of the bolt slide being greatly multiplied by the shape of the cam groove, which acts on the pin at first at a very small angle. The firing pin is in two parts and is inserted by dropping into its recess in the bolt. The sear is so arranged that the trigger cannot be pulled unless the bolt is home and locked, and the bolt cannot be unlocked and moved back until the finger is taken off from the trigger. The latter has a double pull, easy at first, until the firing pin is almost disengaged, then, when the aim is steady, a slight increase of pressure fires the piece. The extractor draws the shell with a positive holding pull, and having no spring, except that the extractor lock at times may act as such. This lock is a positive lock for the extractor when starting the cartridge. It is a bar sliding over the extractor.

When the bolt is locked, and the extractor over the flange of the cartridge, the final movement of the bolt slide pushes the bar forward into the extractor recess, filling this and making it impossible for the

The White Magazine Rifle.

extractor to rise. When the bolt is moved forward, after opening, the bar is retracted, to allow the extractor to spring over the flange of the cartridge. All the parts of the block are interlocking, and there are no screws or threads about it. The whole can be taken apart and put together again in a few seconds.

The clip, holding five cartridges, is inserted as a whole, from above, through the receiver, when the bolt is back, so that no extra movements, as opening a gate, or pushing a spring, are required. Then, on throwing the bolt forward, the piece is loaded and ready to fire. The cartridges are fed up from the clip successively, and when this is empty, it drops out, allowing a fresh cartridge clip to be inserted. The clip is held down by a detent, having a head at the side of the receiver above, in a convenient position, so that it may be pushed down by the ball of the thumb at the same time that the clip is inserted. This operates to move the clip down, so that the topmost cartridge is out of the line of movement of the bolt, and the magazine is "cut off." The head is in the same way conveniently moved up to throw the magazine into operation. It is in plain sight, so that an officer can see whether the soldier has the magazine cut off or not. The arm can be fired as a single loader, with or without the magazine being charged, and with great rapidity. There are but two parts in the magazine, the follower which carries up the cartridge and the spring which presses this up. This is simply placed in a holding socket and requires no screws. The follower always holds the cartridges in the proper position.

As the new smokeless powder greatly increases the heat developed in firing, Lieutenant White has introduced a cooling device in his gun. There is an air space around the barrel, and the gas of discharge rushes out past an orifice at the muzzle and forms a partial vacuum; which, in turn, draws the heated air out of the barrel and supplies its place with cool air entering at the breech. As this is a purely American invention, the final decision of the board of experts upon its merits will be awaited with much interest.

ENGLISH DINING CARS.

On some of the express trains running between London and Glasgow, 401½ miles over the London & Northwestern Ry. and Caledonian Ry. dining accommodation is provided by two dining cars, connected by vestibules, but without communication with the passenger cars, so that passengers can only obtain access to them at certain stops, and must remain until the next stop. The two cars are 50 ft. 6 ins. and 47 ft. 9 ins. long over platforms, the former having platforms at both ends, and the latter a platform or vestibule at one end only. They are 54 ft. 6 ins. and 51 ft. 9 ins. long over the spring buffers, and are both 8 ft. 6 ins. wide, outside, over the body, and 8 ft. 1½ ins. high inside, from the floor to the top of the monitor roof. The longer car contains the kitchen, and has also a pantry, large and small saloon, baggage compartment and lavatory. The saloons are separated by a partition, and are intended to be used for smoking after dinner, no smoking compartment being provided. The larger saloon is 13 ft. 8 ins. long and seats 12 persons, while the smaller is 6 ft. 10 ins. long and seats 6 persons, there being double seats on one side of the central aisle and single seats on the other.

The interior finish is in walnut, with varnished paper headlining and brass fittings and lamps. The seats and tables are of mahogany, the former upholstered in green moquette cloth and plush. The lavatory is finished in sycamore. The kitchen is 10 ft. 4 ins. long and 5 ft. 10 ins. wide, fitted with cooking range, refrigerator, hot and cold water tanks, etc. The pantry, or closet for table linen, china, etc., is 5 ft. 4 ins. × 5 ft. 10 ins. The cars are heated by hot water pipes from a copper boiler with gas burners. They are also lighted by gas. The smaller car has a main saloon 21 ft. 3¾ ins. long; a smaller saloon, 7 ft. 1½ ins.; vestibule, 6 ft. 6½ ins.; women's lavatory, 3 ft. 6 ins. × 7 ft. 11 ins.; men's lavatory, 2 ft. 8 ins. × 5 ft. 3 ins. These saloons have single seats on each side of the gangway, and seat 12 and 4 persons, respectively. The total length over the two cars is 110 ft. 3 ins. They have seating capacity for 34 passengers in all, and weigh 75,000 and 68,000 lbs., respectively.

The cars have steel frames, and are carried on six-wheel trucks with a wheel base of 11 ft. 6 ins. (5 ft. 9 ins. c. to c. of axles), and a distance of 27 ft. c. to c. of trucks. They are fitted with Westinghouse and vacuum brake gear, with brake shoes on four wheels of each truck. The earlier dining cars had radial axles, as stated in our issue of March 30, but the trucks are found to make the cars ride more easily. The cars were built at the company's passenger car shops at Wolverton, to the designs of Mr. J. C. Park, Car Superintendent.

A NEW RULE FOR FILING BRIDGE PLANS WITH THE SECRETARY OF WAR.

A new rule governing the filing of plans with the War Department, in the case of bridges for which the approval of the Secretary of War is required, has just been announced. The rule requires that the plans and drawings accompanying the application for approval must be in triplicate. We print the rule in full as follows:

When application is made, pursuant to the provisions of section 7 of the Act of Congress, approved Sept. 19, 1890, for the approval by the Secretary of War, of plans for a bridge, the applicant will be required to furnish:

1. A copy of the law of the state authorizing the construction of the bridge, certified to by the Secretary of State, under seal.

2. Drawings, in triplicate, showing the plan of the bridge.

3. A map, in triplicate, showing the location of the bridge, giving, for the distance of one mile above and one-half mile below the proposed location, the high and low water lines upon the banks of the stream, the direction and strength of the current at high and low water, with the soundings accurately showing the bed of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of the bridge.

If the applicant is a corporation, in addition to the papers enumerated above, there will be required:

1. A copy of the charter or articles of incorporation of the company, certified, to by the Secretary of State or such other officer as may have the custody of the original, under seal.

2. A copy of the minutes of the organization of the company, certified to by the Secretary of the company, under seal.

3. An abstract from the company minutes showing the present officers of the company, certified to by the Secretary thereof, under seal.

COUNTRY ROADS ON CLAY SOIL.

In a report to the commissioners of Douglas County, Neb., Mr. Andrew Rosewater, City Engineer, of Omaha, gives plans and specifications for various treatment suitable for the main roads leading from Omaha into the country around that city. An abstract follows:

After the first essentials of directness of line and easy grades the important considerations are a stable, unyielding and durable foundation and a road covering that will develope the least resistance to traction, afford a safe footing to horses and wear longest under the influence of traffic and the

elements. The soil to be treated is clay or loam. An earth road, under limited traffic, makes the best of roads, provided it is kept dry to a point below the frost line. Mr. Rosewater provides for this in his plans by subsurface drainage by a central blind drain, in connection with tile drains which have side outlets at convenient intervals. The surface of the road is rounded off and drained by side ditches with frequent outlets through culverts or otherwise.

To compact the earth surface he recommends the use of heavy steam road rollers of from 10 to 15 tons each, the rolling to be done in one-foot layers. For the surface of the road macadam of limestone and telford macadam are recommended. Mr. Rosewater also submits plans for a macadam upon a concrete base; the difference in cost between that and the telford macadam ranging from $1,000 to $2,000 per mile. A road covering of Colorado sandstone on sand, sand and broken stone and on a concrete base are suggested as more costly, but as being better and requiring little attention for years, if well laid.

The subject of tramways on country roads is considered; but they are said to be expensive and require constant care, and would, on a 16-ft. roadway, add 50% to the cost of the macadam pavement, 25% to the Colorado sandstone pavement and 30% to vitrified brick pavement. The tendency to rut along the line of the stringers is also a serious objection to these roads. Their use was not advised. In his plan for vitrified brick pavement Mr. Rosewater suggested that all bids be based upon a five-year maintenance clause, owing to the difficulty of selecting brick throughly vitrified and of equal durability.

THE FIRST GERMAN RAILWAY.

In our issue of Nov. 14, 1891, we reproduced an old engraving showing a train of the first railway in Germany, the Nuremberg-Furth line of 1835. At that time we could find little data relating to this railway, but from a late issue of the London "Railway News" we obtain the following supplemental matter:

This road, connecting Nuremberg with Furth and the first link in a system now aggregating 26,000 miles in length, was advocated by Messrs. Plattner, Scharrer and Ley, worthy citizens of Nuremberg, who were influenced by the successful working of the English railway between Stockton and Darlington. They were at first met with most absurd objections to the scheme by their fellow-citizens, and when these were overcome by argument the more difficult task of raising the money was encountered. Though the committee figured a profit of 12% on the investment, it was fully three months before the total capital of 1,320 shares, of 100 florins each, or about $56,100 in all, was subscribed. For months all pedestrians, horses and carriages passing between the two towns were carefully counted, and it was figured that the annual expense would be about $5,500, and the yearly income $12,500, or at least 12% on the capital.

But Germany was not yet ready for investment in railways; and in 1834 a Bavarian authority attempted to prove that the promoters of the Nuremberg-Furth railway would annually lose 15% instead of gaining 12%. Robert Stephenson, too, wanted $4,000 a year for sending a mechanic and a translator; and this and the difficulty of obtaining the right of way under existing laws made progress so very slow that in 1834 the shares were offered at 30% discount.

At this critical time a Bavarian engineer, Mr. Paul Denis, returned from the United States and offered his services. They were accepted, and about May 1, 1835, work was commenced; and the line was opened to travel on Dec. 7, 1835. The faithful shareholders were rewarded beyond all their expectations, and the shares rose rapidly to 500%. From 1835 to 1860 the line was worked in the forenoon with animal power and in the afternoon with locomotives, for economy's sake. Until 1847 the yearly number of horse trains exceeded those drawn by locomotives, as 4,845 to 4,389. In 1860 the horses were withdrawn. In 1840 the manager was paid a salary of $500 per year; the traffic inspector received $300, and the cashier of the company $200 per annum. The engineman however, sent from England by Stephenson, received $625 per year, or more than the manager. Although the line now has a competitor in the form of a tram-line between the two towns, this first German railway has now a reserve capital of $330,000 and pays 21% dividends on its original share capital, which is still retained.

THE BLOCK SYSTEM OF REPAIRING STREETS AT NEWTON, MASS.

In our issue of April 13, 1893, there appeared a description of a novel method of street repairing in use at Newton, Mass., in 1891. About 22 miles of streets, or 442,000 sq. yds., was divided into ten sections, and each section kept in repair by a gang of men; the cost for the nine months, April to December, inclusive, having been about 1 ct. per sq. yd.

The following additional information regarding this method of repairing streets as practiced during the year 1892, has been sent to us by Mr. A. F. Noyes, City Engineer of Newton:

The method of looking after and caring for the principal streets of the city on the section system, which was inaugurated in 1891, was extended in 1892 to nearly twice the length of street, adding ten more sectionmen, and revising some of the sections of last year. This gave a total of 44.89 miles of street, or 787,230 sq. yds. of street surface, besides the adjoining sidewalks that were cared for by the special men. The total cost of this work for the year was $7,625, which was included in the general repair account. In the first district, which includes Wards 1, 2 and 7, and is in charge of nine sectionmen, the streets are much more thickly settled and in a general way get more travel than in the other districts, and the cost has been about double that in the other districts. The average cost of the nine sections has been 4½ cts. per lin. ft. of street, or 1.42 cts. per sq. yd. of road-surface.

In the second district, which includes Wards 3 and 4, there are seven sections, and the cost amounted to 2½ cts. per lin. ft., or 0.65 ct. per sq. yd. The rate was the same for the four sections in the third district, in Newton Centre, where the sections are a little longer and include a greater area, as there is much less travel on some of the streets cared for.

The average of the sections is about 12,000 ft., corresponding to about 40,000 sq. yds. of roadway. During the year but little new material was added to the surfaces, but the cutting up of the street by sewer trenches necessitated some additional expense in maintaining them.

A novel method of casting steel ingots has been recently developed by Mr. J. B. Nau. As described by the "Iron Age," the essential idea of the process is the casting of the steel in a mold which is surrounded by a furnace, and cooling it from the bottom upward. This method of cooling is claimed to prevent the "piping," or formation of a hollow space at the center of the ingot near the top, which occurs with ingots cast in the ordinary manner. This hollow is due to the metal solidifying on the sides of the mold first, and the cooling proceeding gradually toward the center. At the same time the metal is contracting and pulling the metal at the center toward the sides. This contraction proceeds until an opening or pipe is formed at the center. On the other hand, with ingots cooled from the end the liquid metal above will prevent the formation of any hollow. It is further claimed that blow-holes can in this manner be prevented; the gases which form blow-holes are produced while the metal is still very fluid, and if the metal is solidified from the bottom and is kept hot above, any gases which form can rise through the fluid metal and escape. An important application of the process is expected to be in casting ingots for armor-plates, where the production of a sound ingot, free from blow-holes, is of great importance. It is further claimed that by this method of cooling, an ingot of different composition at top and bottom can be cast, new metal being added before that first poured has solidified at the top. Thus, an ingot of soft steel with a hard steel top could be produced, or the same result would be reached which is obtained in the Harvey process (Eng. News, Oct. 24, 1891), and at less expense.

ELEMENTS OF WEATHER IN THE UNITED STATES OF MOST INTEREST TO ENGINEERS FOR THE MONTH OF FEBRUARY, 1893.

[Furnished to Engineering News by the Department of Agriculture.]

	Station.	Temperature. (Deg. Fahr.)				Wind.			Precipitation—rain and melted snow—inches.		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average	Max.	Min.	Range.	Average	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	24.2	53	−10	63	10.8	36	N	1.21	0.58	10
	Portland, Me.	29.4	52	8	44	9.0	30	SE	3.58	1.44	9
	New York, N. Y.	36.2	53	14	39	12.5	40	NW	4.47	1.87	15
	Pittsburg, Pa.	40.1	73	13	60	8.4	30	SW	1.17	0.22	12
	Chicago, Ill.	33.2	69	9	60	19.9	56	SW	1.69	0.55	15
	Omaha, Neb.	33.6	73	4	69	9.7	34	NW	1.29	0.38	13
	St. Paul, Minn.	23.0	51	−9	60	7.5	27	NW	1.96	0.89	12
	Duluth, Minn.	22.8	51	−6	57	8.1	34	NE	2.28	0.73	8
	Bismarck, N. Dak.	16.9	54	−20	74	9.6	39	NW	1.52	0.72	9
	Average	28.8	58.8	0.3	58.4	10.6	36.2		2.13	0.82	11.4
Southern Cities.	Washington, D. C.	41.1	64	17	47	7.9	36	NW	1.83	0.50	12
	Louisville, Ky.	45.2	78	14	64	10.2	44	W	2.38	0.73	10
	St. Louis, Mo.	43.8	82	10	72	14.4	44	SW	5.10	1.97	7
	Savannah, Ga.	57.0	81	26	55	9.4	44	NW	3.87	1.15	11
	Leavenworth, Kan.	39.8	70	10	60	12.0	42	NW	2.67	0.88	9
	Jacksonville, Fla.	60.6	84	28	56	8.1	48	SW	8.90	2.31	15
	Chattanooga, Tenn.	50.6	80	15	65	7.0	32	NW	2.55	0.80	9
	New Orleans, La.	60.8	79	31	48	11.1	38	W	3.49	1.21	9
	Memphis, Tenn.	51.4	81	16	65	9.5	38	NW	1.95	0.79	8
	Palestine, Tex.	58.0	85	25	60	8.5	34	SW	2.67	1.62	8
	Average	50.8	79.3	19.2	60.1	9.8	40		3.54	1.20	9.8
Western Cities.	Helena, Mont.	30.4	72	6	66	7.1	34	SW	0.14	0.09	3
	Port Angeles, Wash.	40.4	52	28	24	5.3	35	W	2.57	1.35	17
	San Francisco, Cal.	51.2	78	40	38	16.1	43	SE	4.08	0.98	16
	Salt Lake City, Utah.	39.3	73	23	50	6.5	34	SW	2.68	0.73	13
	Denver, Colo.	38.0	80	13	67	8.4	48	NW	0.23	0.16	4
	Yuma, Ariz.	61.5	97	36	61	6.8	33	NW	1.29	0.54	5
	Santa Fé, N. Mex.	38.3	71	18	53	8.6	38	SW	0.78	0.42	6
	Average	42.7	74.7	23.4	51.3	7.5	37.8		1.68	0.61	9.1

The day census of traffic in the "city" of London (the city proper being the central business district) shows 1,186,000 people and 92,000 vehicles entering; and 301,000 persons daily walk into the city. The population of the metropolis of London (or the entire area of London), was 4,211,056, in 1891, for an area of 74,692 acres. The city of London has an area of 668 acres and a night population, in 1891, of only 37,694. The difference between the day and night census, as here given, shows a daily traffic that is not even approached in any other city in the world. The metropolitan and city police districts of London cover 441,559 acres, and included a population, in 1891 of 5,633,332. Some particulars of the city traffic of London were given in our issue of Nov. 24, 1892.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

CROSS FORK.—This company, whose incorporation was noted in our issue of April 20, is building a railway from Shingle Bolt Summit to Cross Fork, Pa., 13 miles. The line is practically a branch of the Sinnemahoning Valley Ry. Pres., W. I. Lewis, Harrisburg, Pa.

SARANAC & LAKE PLACID.—The contract for constructing this 10-mile railway from Saranac Lake to

Lake Placid, N. Y., has been let to Brady Bros., Bayonne, N. J., Pres., C. E. Arnold, Albany, N. Y.

LONG ISLAND.—It is stated that this company has offered to extend its line to East Hamton, Amagansett and Ft. Pond Bay, on condition that the people furnish the right of way. A committee has been appointed to secure the consent of property owners.

CENTRAL R. R. OF NEW JERSEY.—This company has begun work upon a branch to run from Perth Amboy to Bound Brook, N. J. The line was surveyed some time ago.

WILKES BARRE & EASTERN.—Tracklaying has been resumed on this line from Wilkes-Barre to Stroudsburg, Pa.

WEST VIRGINIA CENTRAL & PITTSBURG.—Preperations are being made to begin construction on the Baltimore & Cumberland Ry., from Cumberland to Baltimore, Md. The statement is made that contracts will be let about May 1.

Projects and Surveys.

NORWALK, FAIRFIELD & SOUTHERN.—This company, which proposes to build a railway from Norwalk, O., south to Fairfield, O., 10 miles, is rapidly completing its organization. Pres., John A. Williams, Norwalk, O.

Southern.—Existing Roads.

SOUTH FLORIDA.—Grading is making good progress on the line from Dunnellon to High Springs, Fla., 17 miles, work being under way from both ends of the line.

Projects and Surveys.

TAMPA & WESTERN.—A bill has been introduced into the Florida Legislature to incorporate this company.

TAMPA SUBURBAN.—A bill has been introduced into the Florida Legislature to incorporate this railway company.

KENTUCKY.—It is stated that New York and Chicago capitalists, headed by John C. C. Mayo, of Paintsville, Ky., are making surveys and will begin at once the construction of a railway from Whitehouse to Pikeville, Ky.

FIVE FORKS & DANIELSVILLE.—It is stated that Jas. M. Smith, of Oylethorpe, Ga., is making preparations to build a railway from Five Forks to Danielsville, Ga., 12 miles.

Northwest.—Existing Roads.

DULUTH & WINNIPEG.—The engineers of this company are surveying a line of railroad from La Prairie to the Buckeye mine, in the west end of the Mesaba Range, and from this mine to the Diamond mine. The distance to the Buckeye mine is four miles, and the distance between the two mines is fifteen miles.

Projects and Surveys.

CHICAGO & TEXAS.—This company, whose incorporation was noted in our last issue, proposes to build a railway from East Cape Girardeau, Ill., to a connection with the Grand Tower & Carbondale R. R. Among the incorporators are: Wm. W. Barr, Carbondale, Ill.; Frank H. Butcher, Murphysboro, Ill.; J. P. Foster, St. Louis, Mo.

ESCANABA.—The business men's association of Escanaba, Mich., are about to survey a line to North Escanaba, 4 miles. It is hoped to induce the Minneapolis, St. Paul & Sault Ste. Marie Ry. Co. to build the line.

Southwest.—Existing Roads.

CHOCTAW COAL & RY. CO.—A plan for the reorganization of this company has been adopted under which creditors will subscribe $2,200,000 to the stock of a new construction company which is to build 123 miles of road, completing the road as originally laid out. The road to be built will run from Oklahoma City, O. T., to South McAlester, Ind. Ter. The capital stock of the new company will be $5,000,000. It is to be allowed $18,000 per mile in first mortgage bonds and a bonus of $2,500,000 in income mortgage bonds. The Choctaw stockholders are also to surrender, pro rata, 5,000 shares of the present stock.

CHICAGO, ROCK ISLAND & PACIFIC.—Work on the extension from Bowie toward Ft. Worth, Tex., is making rapid progress. Large quantities of rails are now arriving and tracklaying will soon begin.

MISSOURI, KANSAS & TEXAS.—It is stated that this company has made overtures to prominent Tyler men to build from Mineola to Tyler, Tex., and on to the Trinity River to connect with the Trinity tap, which the company operates. The matter is under consideration.

KANSAS CITY, PITTSBURG & GULF.—Active preparations are being made to build the proposed connections and extensions of this railway, by which a line will be completed from Kansas City, Mo., to Ft. Smith, Ark. In regard to the work, the Joplin, Mo., "Herald" says: The Kansas City, Pittsburg & Gulf Ry. Co. has bought the Kansas City, Fort Smith & Southern, known as the Splitlog road, and expects to be operating 200 miles of road out of Kansas City within the next few months. Contracts were let April 12, which will complete the line to the Arkansas River, and within two years to Texarkana, Tex., whence it will run by way of Shreveport to Sabine Pass. Between Kansas City and Pittsburg, Kan., the Kansas City, Pittsburg & Gulf will be complete by May 1, and a few days later will be in operation. From Pittsburg to Joplin, where the connection will be made with the Splitlog road, there is a gap of 25 miles. The contract for this work has been let to Bernard Corrigan, and calls for a completion of the work in four months. Contractor Corrigan left Kansas City for Pittsburg to begin the work April 12. Over the Splitlog the Kansas City, Pittsburg & Gulf will run a distance of 50 miles to Sulphur Springs, Ark. From this point, under a contract awarded to Corrigan, the road will be built 90 miles south to the Arkansas River, which it will cross near the mouth of the Canadian River. The company expects to push the work south from that point to a connection, not yet fully determined on, with the Choctaw railroad, and then to a connection with the Texarkana railroad.

Projects and Surveys.

TECHE R. R. & SUGAR CO.—Incorporated in Louisiana to build a railway from Huron Plantation, St. Martin's Parish, to some point on the Bayou Courtableau, and thence to some point on the Louisiana & Western Ry. The officers are: Pres., Seaman A. Knapp; Vice-Pres., Geo. Horridge, and Secy., Bradford Knapp.

Rocky Mountain and Pacific.—Existing Roads.

GEORGETOWN & GRANGER.—This company, which proposes to build a railway from Georgetown to Granger, Tex., is pushing its scheme, and the local papers state that the prospects are favorable for early construction.

CHICAGO & NORTHWESTERN.—It is announced that this company has completed negotiations for the purchase of the old Scranton coal road, running from Denver east 17 miles. The price to be paid is $1,000,000. This line will give the road terminal facilities and entrance into Denver.

SOUTHERN PACIFIC.—Work is being actively pushed on the 16-mile extension from Santa Margarita to San Luis Obispo, Cal., Three miles of track from Santa Margarita south have been laid, completing the line to the first tunnel. There will be seven tunnels on the line, and a large amount of heavy mountain work. About 1,000 men are now at work on the line, and this force will be largely increased so as to complete the work this year.

Projects and Surveys.

SALT LAKE & PACIFIC.—This company has been organized at Salt Lake City, Utah, to build the long talked of railway to the Pacific coast.

Foreign.

MEXICAN INTEROCEANIC.—The work of construction of the extension from Jojutla to Puente de Ixtla has activeiy begun. The line will be run near the Hacienda Zacatepec, and will pass the Haciendas San Nicolas Obispo and San Jose Vista Hermosa. From this hacienda the city of Cuernavaca can be seen in the distance. The road will terminate at San Gabriel.

MEXICO.—By mutual consent between the government and the Land & Colonization Co., the concession relative to the construction of a railway from the port of San Benito to the town of Tapachula has been rescinded. The company relinquishes its claims to certain land and colonization franchises, and the government returns the sum of $10,000 in bonds of the public debt, which had been deposited as a guarantee.

ELECTRIC RAILWAYS.

INDIANAPOLIS, IND.—The franchise for an electric street railway system recently offered for sale has been sold to a syndicate represented by Byron K. Elliott. The terms offered were for the first five years 10% of the gross receipts per annum; for the second period of five years, 12½% per annum; for the third period of five years, 13½% per annum, and for the remainder of the time said contract covers and embraces 14½% per annum.

ORANGE, N. J.—Permission has been granted to the Orange Cross Town & Bloomfield Ry. Co. to change its motive power to electricity.

ASHTON, MD.—The Ashton & Clarksville Electric Ry. Co. has been incorporated to build an electrical railroad from Ashton to Clarksville, forming part of the proposed electrical railroad from Baltimore to Washington.

HAGERSTOWN, MD. — Rodgers, Shanly & Co., of New York city, who have franchise to build an electrical railroad in Hagerstown, will commence work within 30 days. W. R. Warfield is the engineer in charge.

CHARLESTON, S. C.—The Enterprise Street R. R. Co. has applied to the city council for a franchise to operate its lines by electricity.

MOBILE, ALA.—Proposals are invited, until May 1, for erecting a power house and car barn for the Mobile Street Railroad Co. Plans and specifications and other necessary information can be had at the office of the company, or at the office of the undersigned. Proposals will also be received for furnishing brick and rough lumber by the thousand. McDonald Bros., architects, Louisville, Ky.

NEGAUNEE, MICH. — The Negaunee & Ishpeming St. Ry. & Electric Co. will extend its line to the Lake Angeline mine.

BRIDGES, TUNNELS AND CANALS.

PITTSBURG, PA.—Plans have been approved for the iron toll bridge from the Twenty-third ward, Pittsburg over the Monongahela, to Homestead. Work on the structure will be begun in July.

CINCINNATI, O.—The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. is considering the construction of viaducts at Wood St.

EAST LIVERPOOL, O.—Preliminary surveys have been commenced for the highway bridge across the Ohio River. It is stated that the structure will be built as soon as the War Department has passed upon the plans now being prepared, which contemplate an iron structure, with a channel span of 500 ft. and a total height above low water mark of 90 ft. This will provide the only wagon bridge on the Ohio River between Wheeling and Pittsburg.

BALTIMORE, MD.—Bids will be received until May 3 for building a bridge over Gwynn's Run. F. H. Smith, Engr., 227 German St.

ELLICOTT CITY, MD.—The Elkridge Bridge Co. has been chartered with a capital stock of $100,000, to build a bridge over the Patapsco River. Chas. Marshall, Wm. T. Levering, Baltimore, Md.

CHESTER, W. VA.—A charter has been granted to the East Liverpool Bridge Co. for the purpose of constructing a bridge across the Ohio River at Chester, Hancock Co., W. Va. The incorporators are: C. P. Dorr, of Addison, W. Va.; Alfred Paull, of Wheeling, W. Va.; J. B. McDonald and F. H. Croxall, East Liverpool, Ohio; E. R. Curtis, Luray, Va.

MONTGOMERY, ALA.—Plans, specifications and bids until May 15 are wanted for the construction of an iron drawbridge over the Alabama River, near Montgomery. C. E. Hails, Secy.

KANSAS CITY, MO.—The City Engineer advises the construction of a new bridge at Bluff St.

HIGHWAYS.

MASACHUSETTS.—The commissioners of Plymouth county will meet May 10 to consider a proposed highway in the towns of Rockland, Hanover and Hanson

RHODE ISLAND.—At the town meeting April 17 the town of Cranston appropriated $40,000 for highways.

NEW YORK.—The supervisors of Queens county will receive bids until May 9 for repairing about two miles of the Jericho turnpike. See advertisement.

ALABAMA.—Colbert county has voted to issue bonds for $100,000 to macadamize the public roads of the county.

LOUISIANA.—The Bowling Green & Ashley Gravel Road Co. has been incorporated by J. O. Broadhead, O. C. Bryson and others; capital stock, $8,000.

WATER-WORKS.

New England.

BANGOR, ME.—Engr. M. M. Tidd, Boston, will report on the water supply.

MECHANIC FALLS, ME.—A water supply from Thompson Lake, some six miles distant, is proposed.

WARWICK, R. I.—The Warwick & Coventry Water Co. proposes to extend its mains five miles, it is reported.

Middle.

GLENS FALLS, N. Y.—The governor has signed a bill authorizing the village to issue $80,000 of 5% bonds for new mains to the reservoirs. May 2 the people will vote on the question.

GRIFFIN'S CORNER'S, N. Y.—The Griffin's Corners Water Co. has been incorporated; $15,000; E. M. Crosby, A. H. Todd and others.

JEFFERSON, N. Y.—The Jefferson Water-Works Co. has been incorporated; $3,000; Chas. E. Nichols, F. F. Craft and others.

HICKSVILLE, N. Y.—Small works are talked of, with a supply from a pond about 1½ miles distant.

JERSEY CITY, N. J.—The date of receiving bids for a new water supply has been postponed until May 1. W. W. Ruggles, Engr.

WOODBURY, N. J.—It is reported that the Treichler Water & Light Co. has been incorporated to supply water and electric lights to Camden, Gloucester City, Woodbury, Wenonah, Pitman, Glassboro and Clayton: $100,000.

ROWZERSVILLE, PA.—At a recent public meeting the people informally expressed themselves in favor of works.

CUMBERLAND, MD.—Engr. Milnor F. Paret, Baltimore, Md., has reported on new works. May 15 the people will vote on issuing $180,000 of 6% bonds for use as follows: $75,000 for new mains and hydrants; $25,000 for pumping engine; $20,000 for improving the well and extending the intake; $60,000 for a reservoir.

Southern.

WELCH, W. VA.—Works are talked of.

HOGANSVILLE, GA.—It is reported that the Hogansville Water-Works & Electric Light Co. has been incorporated; $25,000; T. C. Lane, Frank Wood, R. W. Trimble.

QUINCY, FLA.—Owl Cigar Co. talks of putting in works for a general supply.

FALMOUTH, KY.—Works are projected; estimated cost for 500,000-gallon reservoir, 4 and 6-in. mains, $14,000.

North Central.

JACKSON, O.—It is reported that the people have voted 636 to 132 for works.

NORWALK, O.—A special committee has recommended improvements to the works, and a legislative act has been secured authorizing the issuance of $100,000 bonds for improvements, provided the people vote in favor of such a measure.

NORWOOD, O.—It is reported that the trustees have decided to build a steel tank.

MARTINSVILLE, IND.—The water-works committee wishes bids for pumping machinery until May 3, and for trenching and pipe-laying until May 4.

PORTLAND, IND.—A franchise has been granted to the Portland Water Co., in which W. H. Harkins and John M. Smith are interested. There will be seven miles of mains and 100 hydrants, at a rental of $3,500 yearly.

BAD AXE, MICH.—It is reported that this place will expend $16,000 for works.

Northwestern.

BROOKLYN, IA.—Works are under discussion.

ROCK VALLEY, IA.—The people are to vote on having works.

BUFFALO, WYO.—Engr. Elwood Mead, Cheyenne, has reported on works.

Southwestern.

MIDLOTHIAN, TEX.—A contract for an artesian well for a water supply has been let to L. B. Entry.

BACHELOR, COLO.—The Teller Water Supply Co. has been incorporated to operate in Mineral Co., supply this place, and furnish water to mines; $100,000; G. E. Moffett, T. W. Vincent and others.

Pacific.

PASCO, WASH.—Bonds to the amount of $20,000 are proposed for works.

EL PASO DE ROBLES, CAL.—A report on works has been made to the Crystal Spring Water Co. by Engr. E. H. Barton; estimated cost, $137,170.

SAN DIEGO, CAL.—The city has voted, 9 to 1, it is reported, to issue $665,000 of bonds for municipal works. In 1891 the city leased the works of the San Diego Water Co., with the privilege of purchase.

VALLEJO, CAL.—Contracts for city works have been awarded as follows: Tunnel, Phillips & Searl, $10,500, including $2.75 per lin. ft. for excavation in earth, $5.90 in solid rock, 35 cts. for earth in open cut, 85 cts. per lin. ft. for rock in open cut, and $25 per M. ft. B. M. for timbering; 20,430 ft. of 12-in. riveted pipe to W. W. Montague & Co., San Francisco, for $18,500; 42,928 of 8-in., and 11,493 ft. of 10-in., lap welded pipe to Riffle & Hinkle, Portland, Ore., for $43,250.

Canada.

PETERBOROUGH, ONT.—The company wishes bids until May 1 for 300 tons of 16-in. cast iron pipe, and until May 15 for a 2,250,000-gallon (Imperial) water power pump. W. Henderson, Supt.

ARTESIAN WELLS.

MEDFORD, MASS.—The council has appropriated $12,500 to test driven wells.

SEWERS.

ROCHESTER, N. H.—Bids are asked until May 3 for the 11 miles of sewers mentioned last week.

BROCKTON, MASS.—We are informed by F. Herbert Snow, Cy. Engr., that the contract for the construction of filter beds has been awarded to Chas. McDermott, at $25,634, the other bids being as follows: Thos. D. Maney & Co., $28,914; Moulton & O'Mahoney, $29,916; Gardner C. Luther, $30,709; Troy Public Works Co., $32,542; Everson & Liddle, $32,580; Daniel J. Cronin, $35,720; N. P. Nawn, $38,154; Jones & Mechan, $41,815; National Construction Co., $54,659.

CLINTON, MASS.—Judge C. C. Stone is chairman and W. R. Dame clerk of the special committee to investigate the sewer question.

DEDHAM, MASS.—J. R. Bullard, T. T. Robinson and H. W. Chaplin have been appointed a committee to secure the including of this city in the metropolitan system of drainage.

PITTSFIELD, MASS.—The contract for sewer construction has been awarded to the Troy Public Works Co., at $46,370, other bids being T. L. Allen, Worcester, $48,432, and John Brosnan, New York, $55,700.

WESTFIELD, MASS.—The contract for laying about 16,000 ft. of pipe sewer has been awarded to J. Brosnan, New York, at $11,169. C. D. Allen bid $12,565, and Sackett Bros. $11,970.

WINCHESTER, MASS.—D. W. Pratt, H. C. Miller and F. V. Wooster have been appointed a committee to consider and report a system of sewerage for the town in connection with the metropolitan sewer.

HARTFORD, CONN.—Rudolph Hering, New York, has presented a report showing whereby the sewage of the city can be kept from polluting the Park River. An interceptor is recommended, estimated to cost $174,370.

BROOKLYN, N. Y.—The commissioner of city works will receive bids until May 3 for several pipe sewers. The legislature has authorized the construction of a sewer to extend into Newtown, to cost about $650,000.

FLUSHING, N. Y.—The board of trustees will receive bids until May 10 for 9,500 lin. ft. of 9 to 24-in. sewers. G. A. Roullier, Village Engr.

FORT PLAIN, N. Y.—The sewer commissioners will receive bids until May 13 for a system of sewers.

HERKIMER, N. Y.—At the election April 18 the citizens voted in favor of the proposed sewers; estimated cost, $55,000.

ORADELL, N. J.—Bids are asked until May 1 for 2,500 lin. ft. of 8-in. sewer. A. Landman, Chn. Com.

WEST HOBOKEN, N. J.—The contract for a brick sewer in Summit Ave. has been awarded to Michael Curley, at $15,426, other bids being: Edward O'Neil, $19,225; T. Cavanaugh, $21,881; P. G. Plunkett, $22,040; Dennis Byrnes, $23,200; J. Berkery, $24,000; M. Brennan, $25,450; Peter Tuohy, $25,555; Henry M. McGibney, $27,280; T. Ard, $29,800.

WILMERDING, PA.—The borough council has decided to spend $68,000 for sewers this year.

TAMPA, FLA.—Col. Geo. E. Waring has reported on a sewer system for the city; estimated cost, $158,000.

ASHLAND, KY.—The city clerk will receive bids until May 18 for 4,500 ft. of 24-in. drain tile sewers.

PAINESVILLE, O.—The village clerk will receive bids until May 18 for a main and branch sewer.

BELLEVILLE, ILL.—Edward Flad, St. Louis, Mo., has been engaged by the city council to prepare plans for a general sewerage system.

OTTAWA, ILL.—The city engineer will receive bids until May 2 for about three miles of sewers.

FARGO, N. DAK.—Bids will soon be asked for 3½ miles of additional sewers. J. T. Graves, Cy. Engr.

DES MOINES, IA.—The board of public works will receive bids until May 4 for the 12 to 42-in. sewers mentioned last week.

FORT DODGE, IA.—Plans for a system to cover the entire city have been prepared by C. F. Loweth, St. Paul, Minn. It is reported that bids will soon be asked for the construction.

INDEPENDENCE, MO.—The city engineer has been directed to prepare surveys and plans for a sewerage system.

OKLAHOMA, OKLA.—The lowest bid for the proposed sewers was that of Delaney & Scott, $11,382.

STREETS.

LEWISTON, ME.—The committee on streets has been authorized to contract for paving blocks to cost $25,000.

LENOX, MASS.—The town has appropriated $10,000 for extending the Telford paving in Main St. about 2½ miles.

MALDEN, MASS.—Orders have been passed appropriating $10,000 for brick sidewalks and $4,700 for new streets.

BUFFALO, N. Y.—The department of public works will receive bids until May 4 for 14 contracts for paving with asphalt, sandstone or brick.

BROOKLYN, N. Y.—The commissioner of city works will receive bids until May 2 and 3 for paving with cobblestones.

GREENBUSH, N. Y.—The village trustees have voted to pave two additional streets with granite blocks.

HUDSON, N. Y.—The street commissioners have voted to receive bids for paving Warren St.

ROCHESTER, N. Y.—Ordinances have been passed for paving to cost about $100,000.

ERIE, PA.—The city engineer will receive bids until May 4 for paving with brick, asphalt and Medina stone.

HOMESTEAD, PA.—Engineer Hough reports the cost of the proposed paving of Ann St., between 6th and 14th Aves., at $16,000, estimating brick paving at $1.30 per sq. yd.; grading and sewering Dickson St., $13,420.

HUNTINGDON, PA.—The council is considering a proposition to spend $50,000 in paving.

JOHNSTOWN, PA.—Bids are asked until May 1 for paving Fairfield Ave., 2,400 lin. ft., with fire brick or Belgian blocks; also for constructing four brick arch culverts, with necessary wings and retaining walls. F. A. Cresswell, Borough Engr.

WILMINGTON, DEL.—Bids are asked until May 2 for supplies until April 1, 1894, as follows: curb stone, crossing stone, gutter stone, bluestone gutters, center stone, cement, terra cotta pipe, castings, sewer brick, etc. H. J. Wiley, Secy. St. and Sewer Dept.

WASHINGTON, D. C.—The district commissioners will receive bids until May 6 for laying granite block pavement.

WHEELING, W. VA.—The city engineer has reported estimates for work to be done this coming season, including brick paving to cost about $85,000.

NEW ORLEANS, LA.—The council has voted to pave in 20 streets, and some of the work is being advertised. Square blocks and asphalt will be used, but most of the streets will be paved with gravel.

ALTON, ILL.—Contracts have been awarded to Burke & Ryan, at about $40,000.

CHICAGO, ILL.—The Bermudez Paving Co. has been incorporated by J. R. B. Van Cleave, C. A. Wright and others; capital stock, $50,000.

ALBION, MICH.—Bids will be received until May 2 for about 15,000 sq. yds. paving with vitrified brick. P. M. Dearing, Cy. Clk.

RACINE, WIS.—The city council has adopted resolutions for paving in 12 streets.

NASHVILLE, TENN.—Bids are asked until May 4 for paving about 6,500 sq. yds. with brick. J. A. Jowett, Cy. Engr.

KANSAS CITY, MO.—The city engineer estimates that about ten miles of cedar block paving should be reconstructed this year. About nine miles of paving is now under construction to cost $242,247.

ELECTRICAL.

MADISON, ME.—C. A. Wilber, Village Clk., informs us that the village is obtaining estimates for a municipal electric light plant.

MILFORD, CONN.—The Milford Gas & Electric Light Co. has been incorporated by Henry A. Taylor, James McCarthy and others.

JACKSONVILLE, FLA.—W. D. Wilson, Tarpon Springs, has applied for a franchise for an electric light plant. He offers to furnish 150 arc lights of 2,000 c. p., for five years, at $13,000 per year, each light to burn every night and all night; also incandescent lights of 16 c. p., at $15 each per year, or 25 c. p. at $18.

CLYDE, O.—The village clerk will receive bids until May 9 for an electric light plant.

DETROIT, MICH.—The public lighting committee has been authorized to advertise for bids for an electric light plant, the cost not to exceed $800,000.

CHESTER, ILL.—The Chester Light, Water & Ice Co. will receive bids until May 15 for a central lighting station. The plant will consist of one 35-light arc dynamo, and two 500-light 2,000-volt alternating dynamos, with engines, boilers, etc. Bids are asked on the entire work or any part of it, and should be addressed to Wm. H. Bryan, Mech. and Elec. Engr., 56 Turner Bldg., St. Louis, Mo.

NEW COMPANIES.—General Electric & Improvement Co., Jersey City, N. J.; $500,000; L. A. Chandler, East Orange, and C. N. King, Jersey City. Concord Light & Power Co., Concord, N. H.; $200,000; H. W. Stevens, A. B. Cross, H. M. Cavis, Walker & Bedford Electric Alarm Co., East St. Louis, Ill.; $300,000; W. J. Walker, A. L. Bedford, Emil Starck. Calkins Electric Burner Co., of Ill., Chicago, Ill.; $120,000; C. A. Warren, R. B. Twiss, A. J. Montague. Madison Electric Light & Power Co., London, O.; $10,000; H. H. Prettyman, John Riley, John F. Locke. Salmon City Electric Light & Water Co., Salmon City, Idaho; $40,000; Pres., E. C. Johnson; Treas., Ed. Mungle. Steele Electric Mfg. Co., Dallas, Tex.; $100,000; W. L. Steele, H. M. Sutton, N. A. Searcy.

MISCELLANEOUS.

DAMS.—New Milford, Conn.—We are informed by D. E. Soule that N. Staub, comptroller of the state, and others have secured a charter for a dam in the Housatonic River, four miles south of this place. It is reported that the plans are prepared for a dam to be 300 ft. in length, 25 ft. in height and 30 ft. in thickness.

Waco, Tex.—The legislature has granted the Waco Water Power & Electric Co. the right to construct a dam in the Brazos River, near this city, to be completed within five years.

BUILDINGS.—Denver, Colo.—The board of capitol managers will receive bids until May 20 and 25 for work on the state capitol. See advertisement.

Bangor, Me.—The plans of J. C. Spofford, Boston, Mass., for a new city hall have been accepted, and the contract for construction awarded to Bearce & Clifford, Lewiston.

Hemstead, Tex.—The plans of A. O. Watson, Austin, for a new court house have been accepted. The building will be of brick, and cost about $33,000.

DOCK WORK.—New York, N. Y.—The department of docks will receive bids until May 4 for dredging about 6,000 cu. yds., new crib bulkhead, boat landing, iron awning shed, requiring about 39,000 lbs. standard iron, etc.

CONTRACT PRICES.

WATER-WORKS SUPPLIES.—Milwaukee, Wis.—Contracts have been awarded by the water department as follows: R. D. Wood & Co., Philadelphia, Pa., 100 double-nozzled fire-hydrants, at $33.99 each; John J. Crilley, laying water mains during the year, 25.5 cts. per lin. ft. for 6-in. pipe, 32 cts. for 8-in., 53 cts. for 10-in.; Adlam & Mosher, 44 cts. for laying 12-in. pipe; W. & L. Payne, Fostoria, O., ferrules, at 38.5, 53.5, 83 cts., and $1.20 for ½, ¾, ¾ and 1-in., respectively. The contract for hauling was awarded to B. Welsh.

PIPE.—Syracuse, N. Y.—We are informed that the following contract has been awarded to Chas. Millar & Son, Utica: 36 and 30-in. straight pipe, at $24.20 per ton of 2,000 lbs., to be delivered f. o. b., in this city; 20 to 6-in., at $23.80; 4-in., at $25; specials, 36,000 lbs., at 2.5 cts. per lb. An additional 800 tons may be purchased during the year, in not less than carload lots. Other bids are reported as follows: Howard Harrison Iron Co., Bessemer, Ala., $21.20 per ton for pipe and $55 for specials; McNeal Pipe & Foundry Co. Burlington, N. J., $23.45 for 36-in. down to $25 for 4-in. pipe, and $50 for specials; Camden Iron Co., $24.20 and $50.

BREAKWATER.—San Luis Obispo, Cal.—The lowest bid received by Lieut.-Col. W. H. H. Benyaurd, U. S. Engineer Office, for about 400 ft. of breakwater extension was that of Albert A. Polhemus, San Diego, $1.94 per ton for rock. The original plans call for a breakwater 2,400 ft. in length, of which 600 ft. have been constructed. The present appropriation is $28,000.

GRANITE BLOCKS.—Boston, Mass.—The contract for furnishing the city with 300,000 granite paving blocks has been awarded to the Rockport Granite Co., at $73.50 per M.

PAVING BRICK.—Washington, D. C.—The following bids have been received by the district commissioners for vitrified paving brick: H. S. Hollywood, $18.45 per M. for ordinary, and $25.65 for repressed; American Fire Clay Co., $17.85 for ordinary; J. M. Mack, $17 for ordinary and $17.95 for repressed, $19 for repressed patent brick and $27 for repressed patent block; J. M. Hamilton & Co., $18 for ordinary and $19 for repressed; J. A. Haydon, $17.60 for ordinary and $18.85 repressed; Glade Fire Brick Co., $16.45 for ordinary; State Line Fire Brick Co., $19.95 for ordinary; Frederick Brick Works, $11.50 for ordinary; McMahon, Porter & Co., $17.05 and $18.10 for ordinary and $17.92 for repressed; Reed & Ettla, $17.37 for ordinary and $17.87 for repressed; Shale Brick Exchange, $17.83 and $16.83 for ordinary and $18.83 for repressed.

MACADAM.—Long Island City, N. Y.—The supervisors of Queens county have awarded contracts for repairing county roads, as follows: Calvin Tomkins, $1.52½ per cu. yd. for 580 cu. yds. of stone and screenings, to be delivered at this city, 200 cu. yds. at Little Neck, and 200 cu. yds. at Roslyn; Tuohey & Co., $2.75 per cu. yd. for 400 cu. yds., at Flushing.

GRANITE BLOCK PAVING.—Albany, N. Y.—A contract for paving with granite blocks has been awarded to Jacob Holler, at $2.75 per sq. yd. for new work, and 70 cts. for relaying old blocks.

Troy, N. Y.—Contracts for paving with granite blocks have been awarded to J. H. Cavanaugh, as follows: 5,200 sq. yds. at $2.86, and 10,000 sq. yds. at $3.09; curbing, $1 and $1.05 per lin. ft.; bridging, 55 cts. per sq. ft.; old curbing, 25 cts.; old bridging, 5 and 10 cts.

BRICK PAVING.—Jacksonville, Fla.—The contract for paving Bay St. with brick has been awarded to the Tennessee Paving Brick Co., Robbins, Tenn., at $2.40 per sq. yd.

Marshalltown, Ia.—J. G. Trotter, Cy. Clk., informs us that the contract for paving about 27,000 sq. yds. with vitrified paving brick has been awarded to Gilman & Shorthill, Marshalltown, the itemized bid being as follows: Two courses of brick, on sand, at $1.675 per sq. yd.; one course of brick, on 8 ins. macadam, at $1.69 or $1.76; one course of brick, on 6 ins. concrete, $1.81; curbing, 5×20, or 5×24 ins. Berea sandstone, at 59 cts., or 67 cts. per lin. ft.; Portland cement, at 49 cts.; resetting old curb, at 12.5 cts.; excess grading, at 15 cts. per cu. yd.; overhaul, in excess of 1,300 ft., 1 ct. per 100 ft.

SEWER BRICK AND CEMENT.—Minneapolis, Minn.—We are informed that contracts have been awarded as follows: Wisconsin Red Pressed Brick Co., 200,000 sewer brick, at $8.16 per M.; P. J. Swanson & Co., 500,000 sewer brick, at $7.75; Twin City Lime & Cement Co., Mankato cement at 90 cts., 72 cts. or 63 cts. per bbl., in wood, paper sacks or cloth sacks, respectively; Louisville cement at $1.06, 85 cts. or 79 cts.; "Keystone," Milwaukee cement at $1, 77 cts. or 67 cts.; cotton sacks charged at 10 cts., and credit given when returned, also 5 cts. credit given for each barrel returned.

INDUSTRIAL NOTES.

LOCOMOTIVES.—The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 10 mogul freight engines for the New York & New England; cylinders, 20×26 ins.; weight, 128,000 lbs. The Rogers Locomotive Works, Paterson, N. J., have an order for 15 consolidation engines for the Louisville & Nashville. The Rhode Island Locomotive Works, Providence, R. I., have sent a compound engine to the World's Columbian Exposition, as an exhibit. The Pittsburg Locomotive Works, Pittsburg, Pa., have an order for 16 engines for the Kansas City, Fort Scott & Memphis. The Richmond Locomotive Works, Richmond, Va., have an order for freight engines for the Seaboard Air Line, and have built a two-cylinder compound ten-wheel freight engine for the Chesapeake & Ohio. The Illinois Central will add several eight-wheel passenger engines, mogul freight engines and six-wheel switching engines to its equipment. The Union Pacific has been doing considerable heavy repair work at its shops at Cheyenne, Wyo., where several boilers are also being built.

CARS.—The South Baltimore Car Works, Baltimore, Md., have an order for 700 box cars for the Boston & Albany, the contract amounting to about $400,000. The Minerva Car Works, Minerva, O., have an order for 200 hopper gondola cars, with air brakes and M. C. B. couplers, for the Huntington & Broad Top Mountain, and 100 flat cars of 60,000 lbs. capacity for the Cleveland, Canton & Southern. The Ohio Falls Car Co., Jeffersonville, Ind., has built several passenger and baggage cars for the New York Central, and 25 suburban cars for the Chicago & Northwestern. The Roanoke Machine Works, Roanoke, Va., have built 100 hopper bottom coal cars for the Norfolk & Western. The Illinois Palace Horse Car Co., of Bloomington, Ill., has been incorporated by E. R. Morgan, M. Rosenburg and A. J. Barr, with a capital stock of $10,000, to build cars for conveying horses.

THE FLUSH TANK CO., Chicago, has removed its factory and offices to 135 and 137 West Washington St., Secy., Chas. Poore.

THE INGERSOLL-SERGEANT DRILL CO., New York, has removed its offices to the Havemeyer Building, Church and Cortlandt Sts., the old offices at 10 Park Place being retained as a shipping department. In the new offices a room has been provided for the use of engineers, contractors, etc., and is supplied with the engineering papers, telephone, and other conveniences.

NEW COMPANIES.—Wisconsin Hydraulic & Dredging Co., Milwaukee, Wis.; $150,000; R. B. Mallory, S. Howard and C. Larkin. South Chicago Engineering & Contracting Co., Chicago, Ill.; $100,000; S. Creutz, E. Barrington and C. J. Gummarson. Erwin Welch Hydraulic Machine Co., Chicago, Ill.; $100,000; O. R. Erwin, E. G. Welch and S. J. Lumbard. Air Brake Pressure Regulator Co., Chicago, Ill.; $100,000; B. Wolhaupter, Alexander C. Ray and J. P. Wlborg. City Ditch & Channel Co., Galveston, Tex.; $1,000,000; H. V. Dougan, of Minneapolis; A. W. Wright, of Boston, and C. W. Delvey, of Galveston. Wakefield Reclamation & Sheet Piling Co., Reno, Nev.; $500,000; F. M. Pixley, A. D. Sharon and James M. Allen. American Engine Co., New Bound Brook, N. J.; $200,000; R. V. Pierce and J. Brandt.

PROPOSALS FOR NEW WATER SUPPLY.

Sealed proposals will be received at the office of the Board of Commissioners of Water-Works of the city of Galveston, Tex., until twelve (12) o'clock, m., of the 8th day of May, 1893, for furnishing the city of Galveston with the material and for performing the work outlined in the following approximate amounts:

About 13,117 tons of 2,000 pounds of 30-inch cast iron water pipe.

About 2,177 tons of 2,000 pounds of 30-inch special cast iron water pipe for submerged pipe line.

About 33 tons of 2,000 pounds of miscellaneous cast iron pipe.

About 60 tons of 2,000 pounds of assorted special casting.

About seventeen 30-inch valves; four 36-inch valves and about forty-six valves of other and smaller sizes.

One stand-pipe, 48 inches in diameter by 40 feet high.

One valve well about 18 feet by 20 feet, and 20 feet deep, with house.

One reservoir, 40 feet inside diameter, with house.

One artesian well system, guaranteed to supply 5,000,000 gallons of water per twenty-four hours.

Laying about sixteen miles of pipe on land.

Laying about two miles of 30-inch submerged pipe.

Erecting one pumping station 40 feet by 80 feet.

Furnishing and erecting on foundations two pumping engines, each of 6,000,000 gallons capacity per twenty-four hours, with boilers.

The work must be completed within twelve months from date of contract. Plans can be seen at the office of the Chief Engineer to the Board of Commissioners of Water-Works.

Printed specifications can be had from the City Clerk or Chief Engineer.

The right is reserved to reject any or all bids.

Bids to be for the whole work and for the different divisions of the work, separately, as per specifications.

Proposals must be made upon blank forms attached to specifications, and accompanied by guarantee bond and the sum of $5,000 in cash on the whole, or a proportionate amount on the different subdivisions of the work, as an evidence of good faith; said amount to be forfeited to the city on failure of bidder to enter contract.

Proposals will be indorsed "Proposal for New Water Supply," and must be addressed to A. S. NEWSON, Chairman of Joint Committee on Water Supply.

A. S. NEWSON,
ROBERT HAYES,
GEO. F. SCHNEIDER, JR.,
J. C. SMITH,
WM. REPPEN,
P. N. HARRIS,
L. SCHMIDT,
JOHN WEGNER,
Joint Committee on Water Supply.

W. KIERSTED, Engineer. 15-4t

TO CONTRACTORS FOR SEWER CONSTRUCTION.

CITY OF BROCKTON.

Office of the Sewerage Commissioners.
(Seal.) Room 27, Home Bank Block.

Sealed proposals will be received at this office until 12 o'clock, noon, May 11th, 1893, for furnishing all labor and a portion of the material necessary for the construction of about 10,500 feet of brick sewers, ranging in size from 26 × 39 ins. to 32 × 48 ins., egg-shaped, together with all appurtenant structures. Plans, specifications, and form of contract, may be seen at this office, or will be furnished on application to F. Herbert Snow, City Engineer, Brockton, Mass.

The Commissioners reserve the right to reject any and all bids.

R. P. KINGMAN,
H. A. MONK,
A. C. THOMPSON,
Sewerage Commissioners.

F. HERBERT SNOW,
City Engineer. 17-2t

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received by the Sewer Commissioners of the Village of Fort Plain, N. Y., until Saturday, May 13th, 1893, at 2 p. m., for the construction of a system of sewers in said village. Each bid must be accompanied by a certified check for the sum of $500, drawn to the order of the President of the Board. The Commissioners reserve the right to reject any and all bids.

Plans and specifications may be seen at the office of the Clerk of the Board, or at the office of the Engineer.

DOUGLAS AYRES, Pres.
EDWARD ALLEN,
WILLIAM CLARK,
DAVID E. DUNN,
D. G. HACKNEY,
Sewer Commissioners.

JAMES A. WENDELL, Clerk.
DEWITT C. SMITH, Engineer.
Schenectady, N. Y. 17-2t

SEWERS.

Proposals are wanted until May 2, 1893, for about three miles of sewers, mostly pipe. For information, address

N. C. STUCKER, City Engineer.
17-1t Ottawa, Ill.

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.

Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica, N. Y. Manufacturers of Lead Pipe and Plumbers' Materials. Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.

HOWARD-HARRISON IRON COMPANY,
MANUFACTURERS OF

CAST IRON PIPE

FOR WATER-WORKS, GAS WORKS, CULVERTS.
Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.
Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

ARTHUR KIRK & SON, PITTSBURGH, PA.

POWDER, DYNAMITE, ROCK DRILLS,
AIR COMPRESSORS, ROCK BREAKERS,
Safety Fuse, Electric Batteries, Miners' Squibs.

FOR
Best Results USE THE WARREN FILTER,
—MANUFACTURED BY—
CUMBERLAND MFG. CO., Boston, Mass.

THE STANDARD CONSTRUCTION CO.,
GENERAL CONTRACTORS.
SEWER AND MASONRY BUILDING, STREET PAVING, ETC.
Main Office, Lewis Block, Pittsburg, Pa.

Smoothness of motion, absolute safety and high speed are among the good qualities possessed by
OTIS ELEVATORS.
They are built by Otis Brothers & Co., 38 Park Row, New York.

TO CONTRACTORS FOR SEWER CONSTRUCTION.

Office of the Board of Public Works,
Salt Lake City, Utah, April 8, 1893.

Sealed proposals will be received until 2 o'clock p. m. of Wednesday, May 3d, 1893, for the work of constructing a masonry sewer about 40,000 ft. in length, and from 42 to 64 ins. internal diameter. Plans and specifications, showing the character and extent of the work, will be on exhibition at the City Engineer's Office, Room No. 17, City Hall Building, on and after the 17th inst. Full instructions to bidders, with forms for proposal, contract and bond, will be furnished on application, after the 15th inst.

Address Board of Public Works, No. 161 South Main St., Salt Lake City, Utah.

The right is reserved to reject any and all bids.

By order of the Board.
A. F. DOREMUS, C. L. HAINES,
City Engineer. Chairman.
15-3t

SEWERS, FLUSHING, N. Y.

Proposals to construct in Myrtle Avenue and certain abutting streets, in the Village of Flushing, about 9,500 feet of pipe sewers, ranging in size from nine inches to twenty-four inches, will be received by the Board of Trustees of the Village of Flushing, at their rooms in the Town Hall, until 8 p. m. on the 10th day of May, 1893.

For specifications and information apply to G. A. ROULLIER, Village Engineer, at No. 20 Main Street, Flushing, L. I.

A certified check in the sum of two thousand dollars must accompany each bid.

The right is reserved to reject any or all bids.

By order of the Board of Trustees.
17-2t CLINTON B. SMITH, Clerk.

REPAIRING MACADAMIZED ROADWAY.

Proposals, including the furnishing of material necessary to repair about two miles of the macadamized highway known as the Jericho Turnpike, situated partly in the First and partly in the Second Divisions of Queens County, N. Y., will be received by the Board of Supervisors of said County at the "Asylum," Mineola, until 12 o'clock noon, on the 9th day of May, 1893.

For information and specifications apply to the Division Engineers, as follows: For First Division, G. A. Roullier, 20 Main St., Flushing, L. I.; for Second Division, John J. McLaughlin, Fulton St., Jamaica, L. I.

A certified check in the sum of $500 shall accompany each proposal.

The right is reserved to reject any or all proposals.

By order of the Board of Supervisors, Queens County, N. Y.
16-2t ROBERT SEABURY, Clerk.

PROPOSALS FOR WATER-WORKS.

The Borough of Pine Grove, Pa., will receive sealed proposals, addressed to the Chief Burgess, on and up to 8 p. m., May 23d, for the construction of their water-works, consisting of about 4¼ miles of pipe from 10 to 4 inches in diameter, with special castings, valves, valve bxes, 24 fire hydrants, etc. Earthen dam about 140 feet long and 18 feet high. Proposals will be received for the above work in whole or in part.

Each proposal for pipe-laying or building dam must be accompanied by a certified check, payable to the order of the Chief Burgess, as follows:

For pipe-laying..... $200.00
For building dam..... $150.00

as a guarantee that in case the contract is awarded the parties to whom such award is made will execute the contract with satisfactory security within five days after notification.

The Borough reserves the right to reject any or all proposals.

Specifications and plans can be seen and obtained of the Borough Clerk or their Engineer.

THOMAS B. HUGHES,
Chief Burgess.
AARON T. FELTY,
Borough Clerk.

FRED C. DUNLAP, Engineer.
A. No. 865 N. 29th St., Phila., Pa.
17-3t

COMMONWEALTH OF MASSACHUSETTS METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO BUILDERS OF PUMPING ENGINES.

Sealed bids for the pumping plant for the Metropolitan Sewerage pumping station at East Boston, and sealed bids for the pumping plant for the Metropolitan sewerage station at Deer Island, will be received by the Board of Metropolitan Sewerage Commissioners at its office, 110 Boylston Street, Boston, Mass., until 12 o'clock m. of Saturday, May 27, 1893, and at that time will be publicly opened and read.

The Board will provide at each pumping station, an engine house, boiler house, chimney and masonry foundations for the pumps, and will furnish a fresh-water supply for the boilers up to the interior of the boiler house. The contractor's bid for each plant must be for furnishing, setting up, and completing, ready for use, two pumping engines (or sets of engines), four boilers, piping and all necessary appliances and fittings such as are to be found in pumping stations of the best class.

Each pumping engine must be capable of easily raising 70 cubic feet of sewage per second 19 feet vertically above the level of the sewage in its respective pump-well. Each of the engines must also be capable of raising to greater lifts up to 25 ft. quantities of sewage inversely proportional to such lifts.

Each engine must also be capable of pumping at as low a rate as 15 cubic feet per second, and at all rates between 15 and 70 cubic feet per second.

The foregoing capacities must be demonstrated by suitable trials.

Each bidder must state in his bid the duty he will guarantee for each engine in the duty trials outlined in the general specifications:

Table of Some Approximate Working and Trial Data, Etc.

	Deer Island.	East Boston.
Elevation of the surface of the sewage in the pump-well above datum....	Feet. (Varies from 94.0 to 101.4	Feet. 90.8 to 93.5
Elevation of the bottom of the pump-well is assumed to be..	85.5	80.0
Elevation of the surface of the sewage in the discharge channel above datum.	(Varies from 101.0 to 120.0	105.3 to 112.5
Least lift.....	6.0	14.5
Average lift.....	11.0	15.0
Ordinary maximum lift.....	18.6	19.0
Lift during duty trial at rate of 70 cu. ft. per sec.....	11.0	15.0
Lift during capacity trial at rate of 70 cu. ft. per sec...	19.0	19.0
The elevation of the boiler house floor should be not lower than.....	116.5	116.5

The elevations mentioned above are referred to a datum about 100.64 feet below mean low water of Boston Harbor.

The contractors must provide at each station four steam boilers of such capacity that any three of them can easily supply the necessary steam for the two engines when discharging together 140 cubic feet per second with a lift of 19 feet.

Plans will be furnished by the Board showing the position of the engine houses and the in-coming and out-going sewers at East Boston and Deer Island.

The first pumping engine at each station, and at least two boilers at each station, must be set up, ready to run, before May 31, 1894; the remaining engine, boilers and other appliances before Aug. 31, 1894. A third pumping engine and additional boilers will probably be called for at each station within a few months thereafter, and a fourth engine and additional boilers may be needed in the future. The third and fourth engines and their boilers are not now to be bid for. The arrangement of the plant, however, must be such as will not interfere with the above named extension.

The design of the pumping engines may be of any form which will fulfill the required conditions.

Each bid must be accompanied by drawings showing clearly the size and arrangement of the steam cylinders, pumps, boilers and all other parts of the mechanism and must also show the necessary details for the engine foundations, which are to be provided by the Board.

The specifications, which must also accompany the bid, must give the kind and the quality of the materials of which the various parts are to be composed, the size and the strength of the principal working parts, and the manner in which they are to be constructed, so as to furnish a clear understanding of all points regarding the workmanship, strength, durability, general efficiency of and space occupied by the whole mechanism and plant.

Each bid must be inclosed in a sealed envelope indorsed "Proposal for Pumping Plant for the Metropolitan Sewerage Pumping Station at East Boston" or "Proposal for the Pumping Plant for the Metropolitan Sewerage Pumping Station at Deer Island," and be delivered to the Board or to its clerk.

Each bid must be made on one of the blank forms furnished by the Board, and must be accompanied by a properly certified check for the sum of $1,000, the latter to be returned unless forfeited by the abandoning of the proposal.

The Board reserves the right to reject any and all bids.

Plans, blank forms, general specifications and further information may be obtained at this office.

HOSEA KINGMAN,
TILLY HAYNES,
HARVEY N. COLLISON,
Board of Metropolitan Sewerage Commissioners of Massachusetts.
HOWARD A. CARSON,
Chief Engineer. 13-9t

NOTICE TO SEWER CONTRACTORS.

Sealed proposals indorsed "Proposals for Building Section 6 of the Newton Sewer System" will be received at the office of the City Engineer, City Hall, West Newton, Mass., until Friday, May 5th, 1893, at 12 o'clock m. The award of the contract, if awarded, will be made by the Joint Standing Committee on Sewers, as soon thereafter as practicable. All proposals must be on the blank furnished by said Committee, and must be accompanied by a certified check upon a national bank of the Cities of Newton or Boston, drawn and made payable to the order of the Treasurer of the City of Newton, for $500.

Some of the approximate quantities for the section are as follows: 17,500 feet of pipe sewer from 6 inches to 15 inches; 300 cubic yards brick masonry; 20,300 cubic yards of material to be excavated at various depths.

Plans can be seen, and specifications and form of contract can be obtained at the office of the City Engineer.

Each bidder is required to make a statement indicating what sewer work he has done, and to give references that will enable the Committee to judge of his business standing, and no bid will be received in case the bidder has not looked the work over on the ground.

The Committee reserve the right to reject any and all bids if they shall deem it for the interests of the City of Newton so to do.

HENRY H. HUNT, Chairman; DARIUS R. EMERSON, HENRY TOLMAN, FREDERIC W. TURNER, EDWARD P. HATCH, the Joint Standing Committee on Sewers. ALBERT F. NOYES, City Engineer.

City Hall, West Newton, Mass., April 12, 1893. 15-3t

BRICK PAVING.

Sealed proposals will be received up to 8 p. m., city time, on May 2d, 1893, by the City Council of Albion, Mich., for the grading, curbing and paving with vitrified brick, of Superior Street, from Ash Street to the Lake Shore & Michigan Southern R. R. Bidders will be required to state prices on two kinds of foundation, viz., concrete and plank, and deposit a certified check of not less than 5 per cent. of the amount of the proposal. The approximate quantities are: Length, 1,950 yards. Curbing, 4,035 feet. Paving, 15,000 square yards.

Estimates are also asked upon the following plans over same street and distances: Cost of grading, curbing and paving 18 feet of gutter, both sides of street with cobble stone, and 32 feet in center with vitrified brick; also same, grading, curbing and paving 18 feet of gutter alone with cobble stone; also same, grading, curbing and paving 18 feet of gutter with vitrified brick alone. The right is reserved to reject any and all bids. Plans and specifications, and further information may be obtained from the undersigned. P. M. DEARING, City Clerk.

Albion, Mich., April 10th, 1893. 16-2t

NOTICE TO DEALERS IN VITRIFIED SALT GLAZED SEWER PIPE, PORTLAND AND AMERICAN CEMENT, AND TO FOUNDRYMEN.

Sealed proposals for furnishing about 200,000 feet of salt glazed vitrified sewer pipe and specials, from four (4) to twenty (20) inches in diameter, about 4,000 barrels of American cement, about 1,000 barrels of Portland cement, and 250 cast iron manhole covers will be received at the office of the City Engineer, City Hall, West Newton, Mass., until Friday, May 5th, 1893, at 12 o'clock, m. The award of the contract, if awarded, will be made by the Joint Standing Committee on Sewers, as soon thereafter as practicable. All proposals must be on a blank form furnished by said committee, and must be accompanied by a certified check upon a National Bank of the cities of Newton or Boston, drawn and made payable to the order of the Treasurer of the City of Newton, for $200. Specifications and forms of contract can be obtained at the office of the City Engineer. The Committee reserves the right to reject any and all bids if they shall deem it to the interests of the City of Newton so to do.

HENRY H. HUNT, Chairman; DARIUS R. EMERSON, HENRY TOLMAN, FREDERIC W. TURNER, EDWARD P. HATCH, the Joint Standing Committee on Sewers. ALBERT F. NOYES, City Engineer.

City Hall, West Newton, Mass., April 12, 1893. 15-3t

TO IRON AND STEEL STRUCTURE CONTRACTORS.

The "Board for the Improvement of Park Ave. Above 106th St." invites proposals for the construction, manufacture, and erection of a "four-track" elevated viaduct structure, to be constructed on Park Ave., between 110th St. and the Harlem River, in the City of New York, in accordance with specifications, copies of which can now be obtained, and the plans of the work seen on application at the office of the Board, Room No. 4, No. 132 Park Ave.

Proposals will be received at the office of the Board until the hour of 3 o'clock p. m., on Thursday, the 4th day of May, 1893, at which place and hour they will be publicly opened by the President of the Board.

Blank proposal forms and envelopes for inclosure of same, and any further information desired can now be obtained on application at the above-named office.

By order of the Board:
CHARLES W. DAYTON, President.
New York, March 30.

TO BRICK PAVING CONTRACTORS.

The Board of Public Works and Affairs of Nashville, Tenn., will be prepared to receive bids until 3 o'clock p. m., May 4th, 1893, for paving Spruce Street with brick, between Broad Street and Lee Avenue. Approximate quantity, 6,500 yards. By order of the said Board. Right reserved to reject any or all bids. J. A. JOWETT, City Engineer.
16-2t

GREENVILLE, MISS., WATER-WORKS.

Sealed bids will be received at office of City Clerk of Greenville, Washington County, Mississippi, up to noon on Tuesday, May 2d, 1893, for building city water-works under a franchise system. Bidders to furnish plans and specifications. 14-4t

TO CONTRACTORS FOR PIPE SEWERS.

Sealed proposals for laying about 11 miles of pipe sewers, and constructing the necessary manholes and other appurtenances required for the sewerage system of the City of Rochester, N. H., will be received by the City Clerk until Wednesday noon, May 3d, 1893. The bidder will be required to deposit a certified check in the sum of eight hundred (800) dollars, made payable to the order of the Treasurer of the City of Rochester, to be forfeited provided contract is not executed within five days after notification of the acceptance of proposal. Plans, profiles, and specifications can be seen on application to the Committee on Sewerage, Rochester, N. H., or, at 205 Congress St., Boston.

CHARLES S. BARKER,
J. THORNE DODGE,
CHARLES W. HOWE,
Committee on Sewerage.

J. F. SPRINGFIELD,
City Engineer. 16-2t

TO SEWER CONTRACTORS.

The Board of Public Works and Affairs of Nashville, Tenn., will be prepared to receive bids until 3 o'clock p. m., Tuesday, May 16th, 1893, for constructing sections A, B, C, D and E of the Lick Branch Sewer, and all necessary connections and incidental work.

Contractors may bid on any or all sections; but if more than one section is bid on, the bids must be separate.

The said Board reserves the right to reject any or all bids, and to award the contract as a whole, or in such portions as the interest of the city requires or to award any contract for any section, and to reject all other bids.

All bids must be accompanied by a certified check, payable to the order of the Board of Public Works and Affairs, in the sum of $1,000 for each section of said work bid upon. This check (or checks) to be forfeited by any bidder to whom any bid is awarded and who shall thereafter refuse to enter into a contract to do the work so awarded.

Specifications and drawings can be examined at the City Engineer's office.

Bidders are informed that, according to the act of the Legislature of 1893, no bidder shall employ convict labor in the said work or any part of it.

By order of the Board of Public Works and Affairs. J. A. JOWETT, City Engineer.
16-4t

COLORADO STATE CAPITOL.

Sealed proposals will be received by the Secretary of the Board of Capitol Managers until 12 o'clock, noon, mountain time, on May 20, 1893, for all material and labor required to complete the following work:

Class I.—Steam heating and ventilating.
Class II.—Plumbing.
Class III.—Electric wiring.
Class IV.—Gasfitting.
Class V.—Wood furring.

Drawings, specifications and details can be seen after April 25, 1893, in the office of the Superintendent, Peter Gumry, at the Capitol Building, Denver, Colorado.

Proposals may be submitted for the entire work, or for each class separately, the Board of Capitol Managers reserving the right to accept such proposals as they may deem for the best interest of the state, or to reject any and all propositions.

Proposals must be submitted on blanks furnished upon application to the Superintendent, and no bid will be considered unless submitted on said blanks.

All bidders will be required to furnish a certified check, payable to the order of the Board of Capitol Managers, equal in amount to two and one-half (2½) per cent. of the bids submitted, which amount will be forfeited to the Board in the event of the failure or refusal of any successful bidder to enter into contract with sufficient sureties.

All bids must be sealed and indorsed "Proposal for State Capitol Building. Class No. ——," and addressed to the Secretary of the Board of Capitol Managers, P. O. Box 1242, Denver, Colorado.

By order of the Board:
HERMAN LUEDERS, Secretary.
Denver, April 12, 1893. 16-2t

SPECIFICATIONS FOR BOILERS.

Office of the City Clerk,
Ashtabula, Ohio, April 20, 1893.

Sealed proposals will be received by the Council of the City of Ashtabula, Ohio, until 12 o'clock, noon, May 6, 1893, for furnishing said city with two boilers to be used in the lighting plant of said city. Specification as follows:

Two boilers, each 84 inches in diameter and 14 feet long.

To be built throughout of flange steel 60,000 pounds tensile strength per square inch of section.

106 4-inch tubes in each boiler.

Domes to be 40 inches in diameter and 48 inches high.

Shells to be 7-16 inch thick, heads ½ inch thick.

Boilers to stand a working pressure of 105 pounds steam, and to be well braced.

One manhole in top of shell and one in end of each boiler.

Necessary hand holes put in for cleaning purposes.

All openings for pipes over 1½ inches to have flanges riveted on.

Four heavy side lugs, wall plates and rollers.

All necessary openings for steam pipes, safety valves, blow-off and feed pipes put in.

Full arch fronts, double fire doors with liners, ashpit doors.

Anchor bolts to secure fronts to brick work.

Back arch doors and frames with bolts to fasten to brick.

Grate bars to fill furnaces, to be 54 inches long with ½-inch openings.

Bearing bars for grates. Dead plates 14 inches wide and 92 inches long.

Four pairs brick stays and tie rods.

Two water columns 4 inches, with glass fixtures and gage cocks.

Two 6-inch lever safety valves with exhaust and steam outlets for 6-inch pipe attached to domes.

Two steam gages 6 inches, with cock and siphons.

Two blow-off valves, 2 check valves, 2 stop valves, all 2½ inches.

Smoke connection, connecting both boilers together, ready to carry to brick stack.

Boilers to be tested to 150 pounds hydrostatic pressure and remain tight. Setting plans to be furnished by party getting contract.

Delivery to be f. o. b. Ashtabula.

The right is reserved to reject any or all bids.

By order of the Council;
17-1t A. B. PHILLIPS, Clerk.

SPECIFICATIONS FOR ENGINE.

Office of the City Clerk,
Ashtabula, Ohio, April 20, 1893.

Sealed proposals will be received by the Council of the City of Ashtabula, until 12 o'clock, noon, May 6, 1893, for furnishing said city one engine, specifications as follows:

One Corliss automatic cut-off engine; engine to be of 26-inch bore of cylinder and from 54-inch to 60-inch stroke.

To be well finished and of best workmanship. Specifications to accompany bids, and party receiving contract to furnish foundation and setting plans. Engine to be delivered f. o. b., Ashtabula.

The right is reserved to reject any or all bids.

By order of the Council:
17-1t A. B. PHILLIPS, Clerk.

TO GRADING CONTRACTORS.

110,000 cubic yards of earth grading to be let at once. Work at Dolgeville, N. Y. Profiles and specifications can be seen at office of Alfred Doige, 122 East Thirteenth St., New York, or at the Land Department, Dolgeville, N. Y., on and after Monday, April 24th, 1893.

NOTICE TO SEWER CONTRACTORS.

Sealed proposals will be received at the Post Office, Oradell, N. J., until Monday, May 1st next, at 7 p. m., for the construction of approximately 2,500 lineal feet of 8-in. sewer, together with an outlet and the necessary manholes, flush-tanks, etc. Plans and specifications can be seen at the store of Van Buskirk & Landman, Oradell, N. J., or at the office of Wise & Watson, Civil Engineers, Passaic, N. J.

The Committee reserves the right to reject any and all bids.

A. LANDMAN,
16-2t Chm. of Committee.

OFFICE OF LIGHTHOUSE ENGINEER, Fifth District, Baltimore, Md., April 7, 1893.—Sealed proposals will be received at this office until 2 o'clock p. m. of Wednesday, the 17th day of May, 1893, for furnishing the materials and labor of all kinds necessary for the completion, delivery and erection at the sites of the metal work of Cape Charles and Hog Island Light Towers, Virginia, for a fixed sum for each light tower, or for an aggregate sum for both towers. The bids most advantageous to the United States Government will be accepted. Plans, specifications, forms of proposal and other information may be obtained on application to this office. The right is reserved to reject any or all bids and to waive any defects. ERIC BERGLAND, Captain of Engineers U. S. A., Lighthouse Engineer, Fifth District. 15-5t

U. S. ENGINEER OFFICE, CHARLESTON, S. C., April 15, 1893.—Notice is hereby given to all parties interested in the wreck of the schooner "Kate V. Aitken," in Swash Channel, Charleston Harbor, S. C., or in the cargo, if any, of said craft, that if same are not removed within 30 days it is the purpose of the Hon. the Secretary of War of the United States to treat said wreck and cargo as abandoned and derelict, and cause their removal, as prescribed by Sec. 4, Act of Congress, approved June 14, 1880. Sealed proposals for removing this wreck will be received at this office until 12 noon of May 15, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. 16-4t

U. S. ENGINEER OFFICE, FLORENCE, Ala., March 15, 1893.—Sealed proposals for excavating lock pit, and for furnishing all necessary material, labor and appliances, and constructing a masonry lock for Colbert Shoals Canal, near Riverton, Ala., will be received at this office until 2 p. m., May 15, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. GEO. W. GOETHALS, Capt. Corps of Engineers, U. S. A. 11-4eowt

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for construction of dike in Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

U. S. ENGINEER OFFICE, WILMINGTON, Del., April 11, 1893.—Sealed proposals for dredging in Cambridge Harbor, Md., will be received at this office until 12 o'clock noon, May 11, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 15-4t

U. S. ENGINEER OFFICE, ROOM H7, Army Building, 39 Whitehall Street, New York City, April 12th, 1893.—Sealed proposals for hire of dredging plant for improving Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock, noon, on Friday, May 12th, 1893, and then publicly opened. Specifications, blank forms and all available information will be furnished on application to this office. D. C. HOUSTON, Colonel, Corps of Engineers. 15-4t

UNITED STATES ENGINEER OFFICE, Wilmington, Del., April 18th, 1893.—Sealed proposals for dredging and excavating for the construction of an inland waterway from Chincoteague Bay, Va., to Delaware Bay, Del., will be received at this office until 12 o'clock noon, May 18th, 1893, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office. WM. F. SMITH, United States Agent. 16-4t

U. S. ENGINEER OFFICE, NEWPORT, R. I., April 14, 1893.—Sealed proposals, in triplicate, will be received at this office until 11 a. m., May 23d, 1893, and then opened, for furnishing and delivering 900 barrels of American hydraulic cement; of which 500 barrels are to be delivered at Fort Adams, Newport Harbor, R. I., and 400 barrels at Dutch Island, Narragansett Bay, R. I. For all information apply to W. H. BIXBY, Captain, Corps of Engineers, U. S. Army. 17-4t